SCIENTIFIC AMERICAN

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FOURTEEN TON LOCOMOTIVE CRANE.

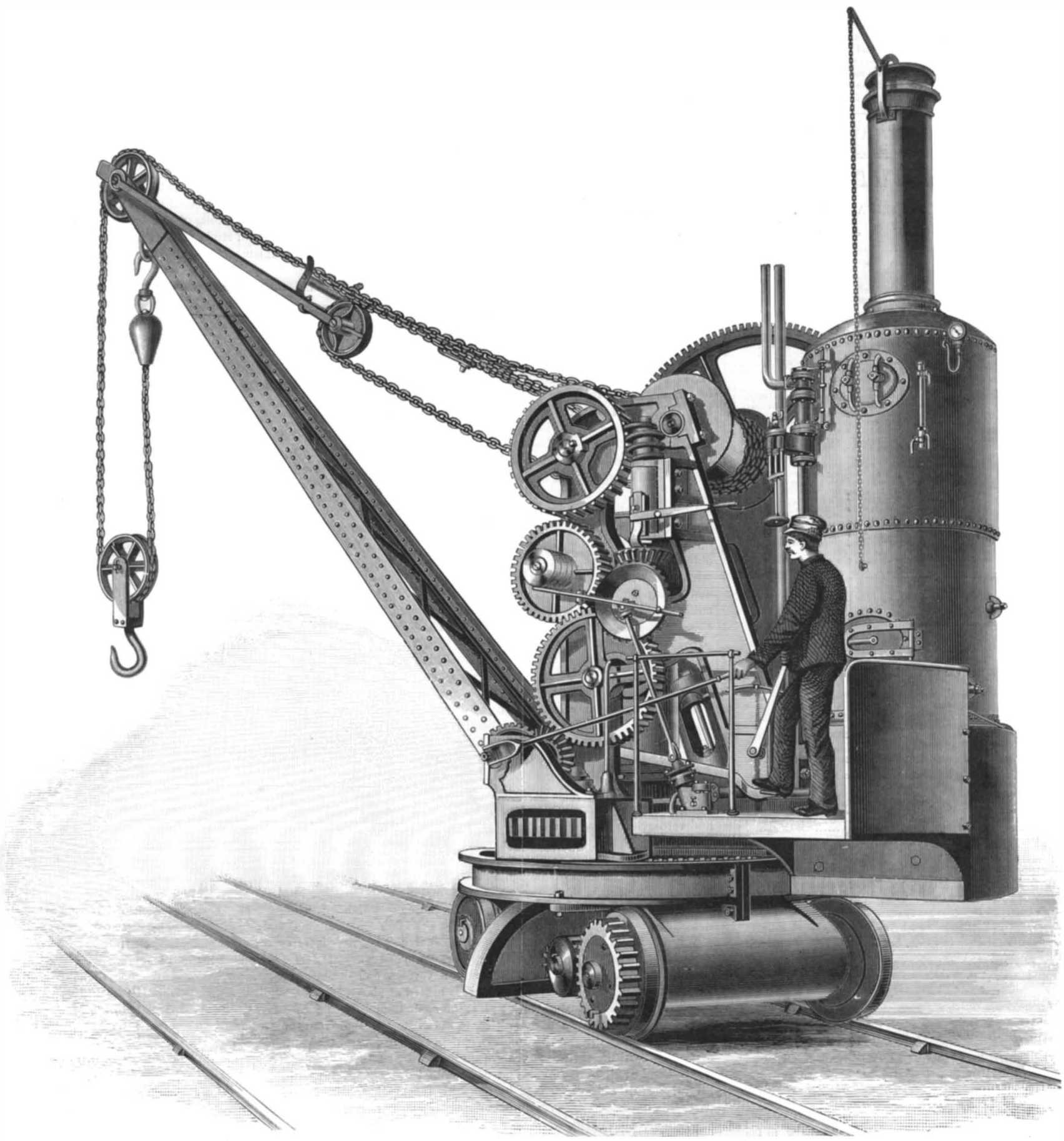
The crane here illustrated is representative of a class of portable steam cranes specially designed and constructed in various sizes for use in steel works. The work to be performed is constant and heavy, night and day, such as ordinary cranes could not cope with. Every part is extra strong, and easily accessible for inspection, while compactness is a prominent feature. In order to be universally available through the works, they travel on the standard railway gauge, and have sufficient stability to lift, slew, and travel with their full load suspended in any position. The engraving is from the *Engineer*, and made from a photograph of the makers' No. 6 standard size, which lifts 14 tons at 12 feet radius, or 12 tons at 14 feet radius. It is the fifth crane supplied to Messrs. Beardmore, of Parkhead Steel Works, Glasgow, but it is the largest yet made capable of slewing and traveling with its full load on ordinary gauge. These cranes are now in use in the principal steel works in England, and several have gone also to America and the Continent.

The carriage is a massive casting of 10 tons, with a fore and aft wheel base of 8 feet center to center. The wheels with steel tires are for a gauge of 4 feet 8½ inches. The axles are of steel, 6 inches diameter, in brass bearings. The traveling gear, wheels, and pinions are of cast steel, and all outside. On each side of the carriage is a strong wing bracket, giving a width over all of about 7 feet, so that a guide rail or bar could be laid parallel to the rails on which the crane travels on each side, in special positions, when the maximum weights may require to be lifted. This is an extra precaution to provide for any jerk or abnormal strain tending to overcome the stability of the machine. These side rails or bars being half an inch under the brackets, would only come in contact when too great strain was put on the crane, and in case of a jerk the crane would immediately settle back on the traveling rails.

One of the special features of this crane is the construction of the central post and its connections. The post with its bearings is the most important detail in such cranes. Messrs. Russell have abandoned the use of the roller path so universally adopted in cranes by other makers; holding that when such cranes are exposed to dust and grit the wear is excessive. If the crane is used so that only a part of a revolution in slewing is performed, that portion of the path wears the remaining portion below the level, so that through time the crane ceases to be able to make a complete revolution. If the roller path and sole plate are cast together, the casting requires occasional returning and even renewal, which is inconvenient.

The small engraving shows an improved arrangement of

(*Continued on page* 132.)



IMPROVED FOURTEEN TON LOCOMOTIVE CRANE.

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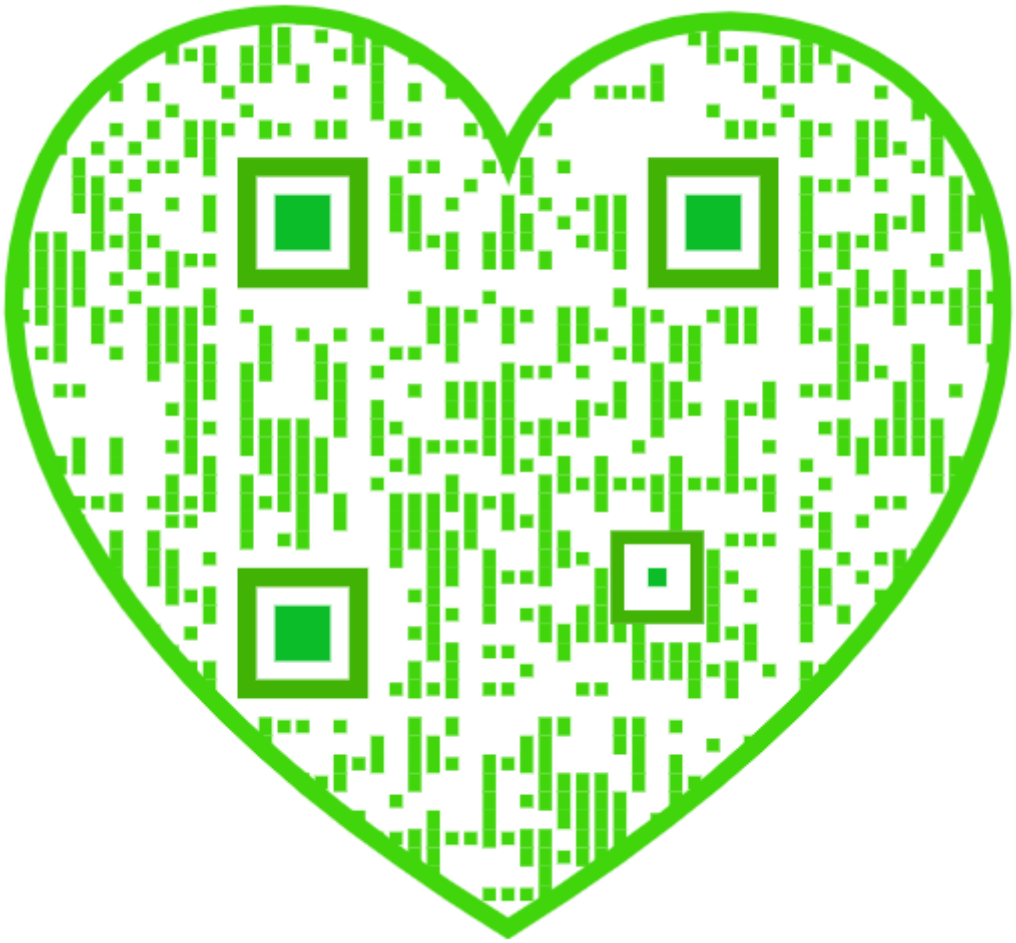

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BALANCING WHEELS AND CYLINDERS.

For wheels of large diameters and wheels and cylinders of great velocity, accurate balancing is required. It is not yet determined that a standing balance and a running balance can be made identical, especially when a belt is used, as on the flywheel of an engine, or the momentum of a crank is to be overcome. But for many purposes the standing balance is near enough to accuracy to prevent tremor and injurious jar in running. When the wheel can be turned inside as well as outside, the rim balancing is not always necessary if the arms approach uniformity in size; but there are cases where inside turning is impossible, and balancing becomes a necessity.

There are three methods of balancing in use, the most common being the suspension of the cylinder or wheel on the centers of an arbor or shaft. This is not always accurate, as, if the wheel is very heavy, the centers must be set up too hard to allow the wheel or cylinder to turn easily.

A better way is to suspend the wheel by the journals on which it is to run; but if these are seated in boxes, the same objection will exist. To obviate this, the journals are sometimes mounted on friction rollers; but a much more accurate method is to mount them on two parallel bars, planed and filed to exactness and fixed perfectly level. These are long enough to allow the journals to travel far enough to make a complete revolution of the wheel or cylinder shaft, 3 inches diameter requiring bars something over 9 inches long. By this method the degree of accuracy obtained is very great, as the journals bear on the bar at only one point, and the mass rolls at a touch.

There is still another method, especially applicable to large turned wheels, as the fly wheels of steam engines. In this the wheel, after being bored and turned, is suspended by the central hole so that the wheel hangs horizontally. The wheel is held by an eye bolt accurately turned, having mounted on it two disks with shoulders turned to fit the bore of the wheel; thus the eye of the bolt is in the mathematical center of the wheel. The wheel is then suspended by a crane, and a spirit level laid on the turned edge of the rim. If the wheel hangs true, the level will show no declination; but the slightest variation of weight will deflect the rim. Pieces of iron are hand clamped on the opposite side, and when accuracy is attained the clamp and weight are weighed, and a pattern for a casting to go inside the rim is made accordingly.

Coloring of Brass.

We translate the following from *Industrie Zeitung:*

If brass be covered with moistened sand for some time a beautiful brown coloration is developed upon the surface, which remains bright when polished with a dry brush. In order to render the color more light or green, it is covered with a film of verdigris obtained by evaporation of dilute acid applied to the surface. The antique appearance of the article thus treated is quite beautiful and more or less lasting. An objectionable feature of the process is the extent of time necessary for its execution, and it has for this reason been substituted by another process.

The brass being heated is immersed in old or dilute nitric acid, and left therein till the surface is covered with scales; it is then cleansed with sand, washed, and bronzed. The term bronze comprehends in commerce all possible colorations.

Brown is obtained by immersion in a solution of nitrate or chloride of iron; the intensity of the color being dependent on the strength of the liquid—for violet colors antimony chloride being used; while a chocolate color is obtained when the surface is covered with a layer of humid iron oxide and highly heated, and polished with graphite. By moistening the brass with a solution containing iron and arsenic chloride, an olive-green is imparted to it. The liquid is prepared by dissolving the respective metals in muriatic acid. The surface is polished with a graphite brush and coated with a lacquer composed of 1 part varnish, 4 parts turmeric, and 1 part gummi gutta.

A steel color is developed by using a boiling solution of arsenic chloride, while a careful application of a concentrated solution of sodium sulphide causes a blue coloration.

Black, being generally used for optical instruments, is obtained from a solution of gold or platinum chloride, to each of which tin nitrate has been added. In Japan the brass is bronzed by using a boiling solution of copper sulphate, alum, and verdigris.

The success in the art of bronzing depends in a chief measure upon the temperature of the alloy and solution, the quality and proportion of the metals used in preparing the alloy, length of time of immersion, drying, and many other particularities—as regards care of the manipulations—which demand a dexterity only acquired by practice.

When it is not the object to impart to the surface an artificial color, but to protect it against the formation of rust or oxidation, a coating of the surface with a varnish called "lacquer" will then suffice. The metal is heated as above, steeped in acid, and washed with water; it is again immersed in pure nitric acid, washed, and dried in sawdust. Or the brass is placed in dilute nitric acid—1 part of acid to 1 part of water—until the surface appears quite white, being then washed and dried as before. The first method produces a bright, the latter a dull surface; by polishing the projecting parts this imperfection is partly overcome. The articles are again immersed in acid, washed with water, containing some crude potassium bitartrate, and dried in hot sawdust. The so prepared articles are heated on a hot plate and then varnished. The varnish used is prepared by dissolving 1 ounce shellac in 1 pint alcohol. Pigments, sandalwood dragon's blood, and annatto are introduced to increase the color and gloss; also turmeric, saffron, gummi gutta, etc. The former produce a yellow, these a red, and a mixture of both a beautiful orange colored varnish.

An excellent light colored lacquer consists of 3 parts aloes, 1 part turmeric, and 1 part plain varnish. A yellow lacquer is composed of 1 part turmeric, 4 parts dragon's blood, and 1 part of the spirit varnish. A red lacquer can be made by mixing 32 parts of annatto, 8 parts dragon's blood, and 1 part varnish.

Lacquers fade and are chemically altered by the combined action of light and heat, and should be kept in vessels of glass or earthen ware; they are also affected by metals.

The Microscope in Analysis.

The recent gift by Andrew Carnegie of $50,000 to Bellevue Hospital, New York city, to be devoted to the furtherance of microscopic study and microscopic investigation, is a step which must go far toward adding to the value of the microscope as an aid to the chemist as well as to the physician and surgeon.

With every improvement in that noble instrument, the telescope, new worlds are revealed to the astronomer, and the science of astronomy owes as much to the skill of Alvan Clark, the instrument maker of Cambridge, as to the patience and learning of Secchi or of Proctor or Langley. So it is in respect to the microscope, and the skillful and ingenious men who are continually improving and perfecting these invaluable instruments. The modern analytical chemist finds a microscope almost as indispensable in his researches, especially in organic analysis, as are his retorts and acids and tubes.

The intricate relation which botany bears to medicine presents a field in which intelligent use of the microscope must produce excellent results. The student of medicine is to-day enabled to unravel, before the potent glance of the perfected microscope, the deepest mysteries of the medicinal plant, flower, herb, or root. The nature, virtues, attributes, etc., of these can be studied at leisure, and gazed upon with an eye that magnifies from a few hundred to thousands of diameters.

The brilliant discoveries by Pasteur and by Koch are as much due to the perfected microscope as to any one cause. The nature and habits of the tubercular bacillus have only been capable of study since the microscope was so improved that organisms heretofore unrecognizable stand revealed. Disease has been traced to its source, the presence of bacteria and germs, by the use of the finest microscopic appliances; and in fact a thorough course study in the art of intelligently using this instrument is becoming yearly a greater necessity, not only to the medical student but the pharmacist who wishes to keep abreast of the age we live in. The relation of the microscope to cholera is at present an interesting and close one. And when another potent servant of man, electricity, is summoned to aid the microscope, the power of the latter is increased to an astonishing degree. Recently in London such an apparatus threw upon a screen the image of a cholera germ, magnified two million times, and in which these long hidden and minute organisms appeared the size of the human hand.

The motto of the modern microscopist seems to be: "There is nothing hidden that shall not be revealed." And the determination of the modern student of medicine and of drugs and their effect and nature should lead him to expend less upon cigars and divers luxuries and aim to be the possessor of an instrument without which three-fourths of the realm he proposes to enter will remain invisible. Fortunately, the growing perfection of the instrument does not imply increased cost. And it is now possible to secure a microscope of marvelous power for a sum which a decade ago would by no means have secured a much less perfect instrument.

We are satisfied, concludes the *Independent Record*, of this city, that in the next few years the microscope, in the hands of brainy and quick witted American students, must pave the way for discoveries in the realm of medicine that will be worthy of a place beside those of Pasteur or of Koch.

A New Revenue Cutter.

The Commodore Perry, a United States revenue cutter, just completed by the Union Dry Dock Co., of Buffalo, for service on the great lakes, is an iron steamer of 451 tons displacement. Her length over all is 161 feet, on the water line 145 feet, beam 25 feet, depth 11 feet 2 inches, draught of water 9 feet. Her rig is that of a topsail schooner. Her engines and boiler were constructed by the Hartford Engineering Co. The boiler is a return tubular, 15 feet long and 11 feet 6 inches diameter of shell. She has a single direct acting engine, cylinder 38 inches diameter and 40 inch stroke, single screw propeller 10 feet in diameter and of 4 blades. Her decks and spars are of white pine. All hands from the captain down are quartered below the main deck; the captain's cabin is in the extreme stern next the ward room. The engine and boiler are amidships, and the men forward.

The woods used for finishing are white pine, black walnut, mahogany, cherry, and ash. She is a neat, handsome little steamer, inside and out, in every way creditable to the builders. An excellent drawing of the vessel has been made by Mr. Frank R. Rosseel, of Buffalo.

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ASPECTS OF THE PLANETS IN SEPTEMBER.

SATURN

is morning star, and wins the first place on the planetary record, for his beautiful appearance in the eastern sky, and also beeause he reaches one of the great time marks in his course.

On the 16th, at 10 o'clock in the morning, he is in quadrature with the sun on his western side. He then passes the half-way house between conjunction and opposition, and is in favorable position for observation, both with the naked eye and the telescope. He is at the same time conveniently situated for the star gazer, rising now at half after 11 o'clock in the evening, and, at the close of the month, making his appearance at half past 9 o'clock. For a time after his advent Saturn is the brightest star in the myriad host that sparkles in the star depths, but his supremacy lasts but a few short hours, when his fair rival, Venus, appears upon the scene and robs him of the proud distinction.

A peculiar interest is felt in the approach of the ring-girdled planet to the earth at the present time, for knotty problems are to be investigated—with little expectation of their being solved—connected with the complicated Saturnian system. The most magnificent member of the planetary brotherhood is drawing near the terrestrial domain under conditions that will not be exactly repeated until the present generation of astronomers has given place to the one that will succeed it. For though the members of this profession are distinguished for longevity, 25 years spans the length of the highest power of observation in an astronomer's life, while 29½ years must pass before Saturn presents the same advantageous position he now holds.

During this year and the succeeding year the finest telescopic views of Saturn and his rings may be obtained in northern latitudes. For in this time he passes his perihelion, reaches his greatest northern declination, and his rings are open to their widest extent; these events all occurring before the year 1885 closes.

The composition of Saturn's rings is a question of profound interest to men of science. When the rings were first discovered astronomers saw nothing wonderful in the fact that two rings surrounded a planet, and accompanied it in its revolution around the sun, any more than a child wonders at the creations of fairy-land. But as a knowledge of the science and the principles of gravitation advanced, it was found that if such a body were solid it could not be supported, but would soon be precipitated upon the planet. There are those who still believe that the rings are approaching the planet. According to Struve's figures, the fall will take place about the year 2150. The theory next advanced was that the rings were fluid. This was shown to be equally untenable. The next and last important step was a great advance upon the preceding, for the distinguished astronomer to whom it is due proved that there were unanswerable objections against both the solid and fluid constitution of the rings; he also suggested or revived a third theory. This is that the ring is formed of myriads of satellites, too small to be separated in the most powerful telescopes, and too close together to allow the intervals that separate them to be visible. The rings look solid and the surface unbroken on account of the immense distance at which they are observed, something on the same principle that the little drops of moisture, of which cloud and fog are composed, appear like solid masses as we look upon them.

The rings, as is well known, consist of two rings separated by an opening, while the inner ring is joined at its inner circumference to a third or dusky ring, considered partially transparent. There is also a line that looks like a division in the outer ring. A broad field here opens to investigators, and observers will carefully study the golden circlet in order to find if the comparative darkness of some portions of the rings is not caused by the sky showing through the openings where the satellites are more sparsely congregated, instead of being breaks in the rings, and whether the dusky ring is not partially transparent.

No effort will be spared, no human aid will be unused, no favorable night will be lost, in the attempt to discover the weighty secrets our brilliant brother has hitherto kept hidden from mortal vision. If a few extra satellites chance to be picked up, while his faee and rings are being scanned, immortal fame will redound to the fortunate discoverers. This year, then, and the year to come are to be specially devoted to Saturnian investigation, a study of exceeding delicacy, requiring exceptional visual power and the long practice that makes perfect. For objects viewed at a distance of 900,000,000 miles demand the highest exercise of the highest powers with which humanity is endowed.

We have proof that the present favorable conditions for observing Saturn are being diligently improved. The Messrs. Henry, of the Paris Observatory, have recently made observations on the mysterious rings under atmospheric conditions that were exceptionally favorable. They make the startling announcement that, outside of the known rings, there exists a small bright ring on the outer border of the outer ring, the width being nearly equal to the division in the ring. Now if this new ring is a reality, other astronomers will not fail to see it, and the opinion will not fail to be confirmed that important changes are taking place in the rings, especially in the outer one. There is a curious analogy between the solar system and the Saturnian system. The sun has eight planets and a ring of asteroids revolving around him. Saturn in like manner is surrounded by eight moons and a ring of minute bodies corresponding to the asteroids. Some time in the future the reason for the correspondence may be discovered.

The right ascension of Saturn on the 1st is 5 h. 30 m.; his declination is 21° 51′ north; and his diameter is 16·8″.

Saturn rises on the 1st not far from half past 11 o'clock in the evening; on the 30th he rises at half past 9 o'clock.

VENUS

is morning star, and seems as yet to show no symptoms of the falling off in brilliancy and size to which she must as surely succumb as the less glorious members of the family. She continues to travel westward, lengthening out the invisible chain that binds her to the sun until the 21st, when a change comes. On that day, at 7 o'clock in the morning, she reaches her greatest western elongation, being then 46° 6′ west of the sun. Here she reverses her course, approaching the sun with slower step than she receded from him, and gradually growing less brilliant as she draws near the central fire that will quench her lesser light.

One cannot help regretting that the bright planet must lose her luster, especially after the superb aspect she took on during the month of August, when she seemed to illumine the eastern heavens like a young moon as she hung tremulous on the rosy waves of light that proclaimed the near approach of the sun.

The right ascension of Venus on the 1st is 7 h. 45 m.; her declination is 17° 11′ north; and her diameter is 30·4″.

Venus rises on the 1st about 2 o'clock in the morning; on the 30th she rises about a quarter after 2 o'clock.

JUPITER

is morning star. Though the latest comer among the planets that usher in the day, he is far enough from the sun to be easily visible, rising now an hour and a half before the great luminary, and two hours after Venus, who looms above the eastern horizon at 2 o'clock. One of the delightful observations of the month will be to watch the approach of the king and queen of the stars as they draw near each other on the celestial road. On the 19th Jupiter is only an hour behind Venus, and, at the end of the month, he follows so closely in her steps that only the short time of 15 minutes separates them. Observers who command the eastern horizon, and will take the trouble to rouse from their slumber in the small hours of the morning, will behold one of the finest exhibitions our brother planets can get up.

The brightest gem of the sun's family appears suddenly above the eastern hills, shining with dazzling brilliancy on the dark background of the sky, the prince of planets follows in quick pursuit, and the first magnitude star Regulus in near proximity completes the starry picture.

The right ascension of Jupiter on the 1st is 9 h. 34 m.; his declination is 15° 10 north; and his diameter is 30″.

Jupiter rises on the 1st about 4 o'clock in the morning; on the 30th he rises about half past 2 o'clock.

URANUS

is evening star until the 20th, when he becomes morning star. On the 20th, at 10 o'clock in the evening, he is in conjunction with the sun. The four great planets are then on the sun's western side, and are all shining as morning stars. Neptune and Saturn have passed quadrature, and are more than half way advanced toward opposition. Jupiter is on the way to quadrature, and Uranus is just commencing his course for the same goal.

The right ascension of Uranus on the 1st is 11 h. 51 m.; his declination is 1° 40′ north; and his diameter is 3·5″.

Uranus sets on the 1st about a quarter after 7 o'clock in the evening; on the 30th he rises about a quarter after 5 o'clock in the morning.

MERCURY

is evening star until the 19th, when he joins the ranks of the morning stars. On the 19th, at 10 o'clock in the morning, he is in inferior conjunction with the sun, passing to his western side, and increasing the number of morning stars to five in the following order of distance from the sun: Neptune heads the list and is succeeded by Saturn, Venus, Jupiter, and Mercury.

The right ascension of Mercury on the 1st is 12 h. 11 m.; his declination is 5° south; and his diameter is 8·6″.

Mercury sets on the 1st soon after 7 o'clock in the evening; on the 30th he rises about half past 4 o'clock in the morning.

NEPTUNE

is morning star and the leader of the shining brotherhood. He is of little importance now in his distant quarters, but we have faith that some time in the future he will point the way to a world or worlds lying beyond his sphere. Meantime his ethereal path must be closely watched, lest any unusual perturbations escape detection.

The right ascension of Neptune on the 1st is 3 h. 25 m.; his declination is 16° 54′ north; and his diameter is 2·6″.

Neptune rises on the 1st about half past 9 o'clock in the evening; on the 30th he rises at a quarter before 8 o'clock.

MARS

is evening star, the sole representative of that role through the whole month. He is moving slowly toward conjunction, but we must wait till 1886 for another opposition, when the ruddy planet will take on a more imposing aspect.

The right ascension of Mars on the 1st is 13 h. 23 m.; his declination is 8° 46′ south; and his diameter is 4·8″.

Mars sets on the 1st soon after 8 o'clock in the evening; on the 30th he sets at 7 o'clock.

THE MOON.

The September moon fulls on the 5th at 4 minutes before 6 o'clock in the morning, standard time. On the 10th, the moon is in conjunction with Neptune; on the 12th, with Saturn; on the 15th, with Venus; on the 16th, with Jupiter; on the 19th, with Mercury and Uranus; and on the 22d, with Mars. No planet is occulted by the moon in September in any part of the globe, but some favored mortals may see her pass over the star Aldebaran on the 10th, and we shall see her in his vicinity.

THE HARVEST MOON.

An interesting lunar phenomenon will occur when, after the full, the moon rises for four consecutive evenings with an average interval of 35 minutes between the time of rising. We may not think with the agriculturists of old that, by a merciful interposition of Providence, the day is thus apparently prolonged to help the husbandman in his labor. But we may be equally grateful for the charm of the landscape when floods of silvery moonlight quickly succeed the short September twilight, and show the artistic touch of our satellite in producing effects of light and shade that no human pencil can reproduce in its perfection of stillness, softness, and serenity, so deliciously harmonizing with nature's great harvest festival.

Krakatoa.

At the meeting of the Meteorological Society of Mauritius on May 22, several interesting communications were made with regard to this eruption; among others, a letter from a M. Lecompte, dated at Diego Garcia (latitude 7° 20′ south, longitude 72° 35′ east of Greenwich) on April 24, describing how at breakfast, on the morning of August 27, they had heard detonations, low but violent, and, attributing them to a vessel in distress, had run, and had sent men, to different ponts of the shore of the island, who were unable to see anything to cause such sounds; also how the captain and mate of the Eva Joshua, just leaving Pointe de l'Est to anchor at Pointe Marianne (these places are supposed from the account to be near Diego Garcia), had heard the same detonations, and sent men to the mastheads, without seeing anything. These, with the previous reports from Rodriguez, showed that in three distinct cases the sounds of the Krakatoa explosions were plainly heard at distances of at least twenty-two hundred miles, and, in the case of Rodriguez, of nearly three thousand.

In *Nature*, May 1, it was stated by Herr R. D. M. Verbeek that these sounds were heard in Ceylon, Burmah, Manila, New Guinea, and at Perth, on the west coast of Australia, and, in fact, at all places within a radius of about 30°, or two thousand miles. But these later reports from Rodriguez and Diego Garcia show that across the waters of the Indian Ocean, with no land intervening, they were carried distinctly to much greater distances.

The still more remarkable atmospheric gravity waves which traveled round and round the globe in all directions from the Straits of Sunda, and which were fortunately registered on the self-recording pressure gauge of the large gasometer at Batavia, close by Krakatoa, were also registered on the barograms at Mauritius; and here there were distinctly recorded four successive transits of the waves from east to west, and three from west to east, the same as shown by Gen. Strachey to have occurred at some of the European stations. But, what is still more remarkable, there is a faint trace of a *fifth* transit of the waves from east to west on the morning of September 2, *i. e.*, *more than six days after the explosions*, and when the waves had traveled *more than four times round the earth*, or about a hundred and two thousand miles.

Overwork in German Schools.

After forty-two years' experience it is now virtually conceded in Germany that physical exercise is not a sufficient antidote to brain pressure, but that where the evil exists, the remedy must be sought in the removal of the cause.

Official action with reference to over-pressure has been taken in Prussia, Saxony, Würtemberg, Baden, Hesse, and Alsace-Lorraine.

The commission appointed by the stadtholder of Alsace-Lorraine recommended that the number of study-hours should be restricted to twenty-six a week for the lowest classes of the gymnasia, and to twenty-eight and thirty-two for the higher; that the hours of home study should be eight, twelve, and eighteen a week, progressing from the lowest class to the highest; and that six hours a week should be devoted to general physical exercise, including swimming, open air sports, skating, and excursions. While the existing conditions will be somewhat ameliorated by these decrees, they do not seem to have brought about a final solution of the difficulty. Last year a petition upon the subject, signed by eminent teachers, physicians, and other citizens, was addressed to the Prussian Chamber of Deputies. After setting forth the deplorable effects of the excessive strain upon the nervous system of scholars, it appealed to the patriotism of the deputies to put an end to the abuse, which, the petition aserts, "threatens little by little to reduce the cultivated classes of society to a state of moral weakness that shall render them incapable of great and manly resolution."

AN inventory of the estate of the late Cyrus McCormick, the inventor of the harvester, has been filed in the Probate Court of Cook County, Ill. The total is not far from twenty million dollars. The executors of this colossal trust furnished a bond for thirty millions.

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A Forty Thousand Dollar Horse.

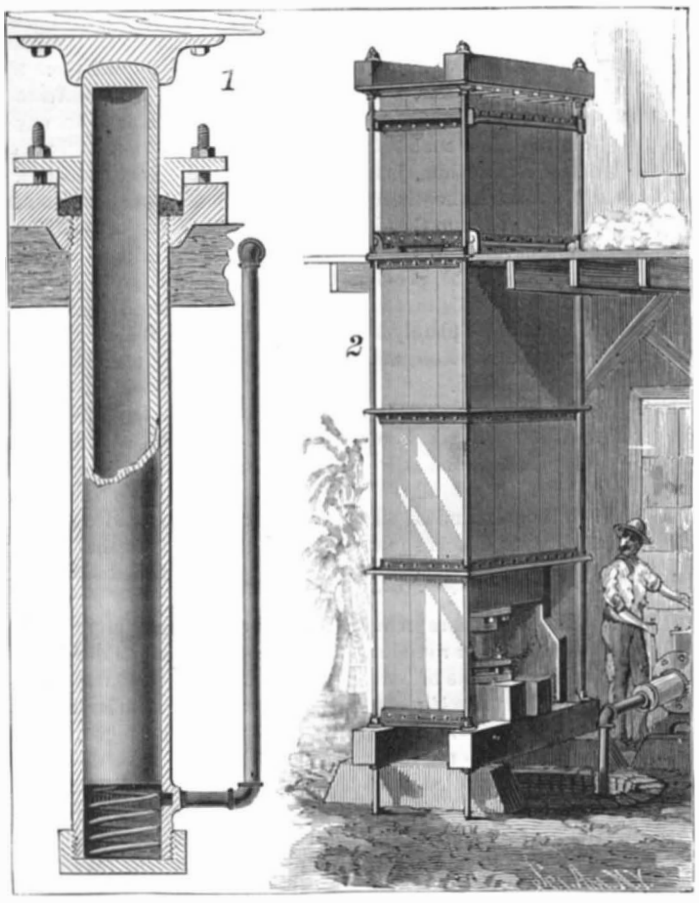
Mr. Wm. H. Vanderbilt has lately sold the famous trotting horse Maud S. to Mr. Robert Bonner, editor of the N. Y. *Ledger*, for the sum of forty thousand dollars. An offer of one hundred thousand dollars from professional turfmen was previously refused by Mr. Vanderbilt, as he preferred to have the animal go into the hands of a private individual.

Maud S. is believed to be the fastest trotter in the world. Her best mile record is 2 min. 9¾ sec. At 4 years of age she trotted a mile in 2:17½, and Mr. Vanderbilt then bought her for $21,000. She is a beautiful chestnut colored mare, long neck, satin skin, brown eyes.

COTTON BALING PRESS.

In the annexed engraving Fig. 1 is a sectional elevation of the hydraulic apparatus, and Fig. 2 is a perspective view of a cotton baling press recently patented by Mr. C. Baumgarten, of Schulenburg, Texas. The manner of constructing the press proper is clearly shown in the cut. In the hydraulic portion of the press is a tube of suitable size and length, which is hermetically closed at its lower end by a cap, screwed on, and upon whose upper end is screwed a strong collar having an annular recess in the upper side around the hole, into which the upper end of the tube screws. This collar is formed with holes to receive stud bolts by which the gland is held down on a ring of elastic packing.

In this tube is fitted a second tube, for a piston, which is



BAUMGARTEN'S COTTON BALING PRESS.

closed at the ends by plugs welded in, and on the head is seated a metal cup having a socket to connect with the piston by simply resting on it, and the follower is attached to the cap by bolts. To check the piston and prevent damage in case it should accidentally fall too rapidly, and to prevent the piston falling below and closing the water pipe, there is a strong coiled spring arranged beneath it. At the lower end of the outer tube is connected a pipe through which water is forced in to raise the piston. This pipe is provided with a conveniently located check valve, and is connected with a pump for forcing in the liquid. The cylinder may be placed in a pit with the collar at the surface of the ground, so that the follower and case may be arranged low down on the ground floor when it is desirable to do so.

The Railways of the United States.

The introduction to the 17th annual number of Poor's Manual, just published, comprises the following interesting and valuable review for 1883:

The accompanying statements show a mileage at the close of the calendar year 1883 of 121,592 miles, 6,753 having been constructed within the year. The total length of completed road at the close of the com panies' fiscal years was 120,552 miles. The average mileage operated during the year was 110,414. The amount of share capital issued by the several companies up to the close of their respective fiscal years was $3,708,060,583, an increase from the previous year of $207,024,759. The funded debts of the several companies amounted to $3,455.040,383, an increase from the previous year of $219,497,060. Their floating or unfunded debts amounted to $332,370,345, an increase of $61,199,383 from the previous year. The total increase of share capital and of funded and floating debts from the previous year equaled $477,721,202. The total amount of all liabilities at the close of 1883 was $7,495,471,311. The total per mile for completed mileage was $62,176. The total of stock and liabilities for 1882 was $7,016,750,109; per mile, $61,303. The total for 1881 was $6,278,565,052; the amount per mile, $60,645. The total for 1880 was $5,402,038,257; per mile, $58,624. The total for 1879 was $4,872,017,517; per mile, $57,730.

It is to be observed that although, since 1879, the actual cost of construction per mile has steadily diminished, very few expensive lines having been built, and during the last half of that period the cost of all construction material being unusually low, the apparent cost as represented by share capital and debt has steadily increased. The increase of cost in the four years since 1879, as represented by share capital and debt, equals $4,446 per mile, and for the whole number of miles, 120,552, constructed a total of $535,974,192.

The gross earnings of all the roads for their several fiscal years of 1883 were $823,772,924, an increase from the previous year of $53,563,025.

Of the gross receipts $215,287,824 were received from passengers, $549,756,695 from freight, and $58,728 405 from miscellaneous sources. The net earnings for the year were $336,911,884, an increase of $21,461,082 from the previous year. The amount of interest paid was $173,139,064, an increase of $18,843,684 from the previous year. The amount of dividends paid was $102,052,548, an increase of $21,114 from the previous year. The percentage in 1883 of gross earnings to investment was 10·99 per cent.; in 1882, 11·74; in 1881, 11 18; in 1880, 11·36; in 1879, 10·80. The percentage of net earnings to investment in 1883 was 4·49 per cent; in 1882, 4·81; in 1881, 4·56; 1880, 5·04; and in 1879, 4·40 per cent. The earnings per mile of all the railroads operated for 1883 were, gross, $7,461; net, $3,051; in 1882, gross, $7,377; net, $3,005; in 1881, gross, $7,548; net, $3,078; in 1880, gross, $7,475; net, $3,318; in 1879, gross, $6,652; net, $2,761.

Grand Canon of the Colorado.

At the last meeting of the Academy of Sciences, San Francisco, Prof. Davidson spoke of his recent visit to the Grand Canon of the Colorado at a point 160 miles east of the Needles, on the Atlantic and Pacific Railroad, which required only 21½ hours' time, and an expense of $10 for horses and guide and 75 cents a meal. He saw vertical walls 2,700 feet high, 6,200 feet above sea level, where the Colorado River was 190 feet deep, and cannot imagine anything grander than the effect of sunset shining on these walls, only 10° from vertical, composed of different colored rocks, red sandstone, and the black overhanging rocks. The temperature was 136° Fahrenheit.

PAPER AND CARD CUTTER.

The top plate on which the paper is placed is supported at the ends by two-leg, braced frames. Held longitudinally above the plate is a clamping bar that is held in position by screws which pass through fixed nuts on the ends of the top plate, and which are provided at their lower ends with crank handles. Formed in each side edge of the bar is a groove, in which slide tongues formed on a cutter head resting on the upper surface of the bar. Mounted in upwardly projecting lugs on the cutter head is a shaft on each end of which is a handle. Projecting downward from the shaft is an arm carrying a cutter blade, the inner edge of which rests against the side edge of a projection on the clamping bar. As soon as the handles are released, the cutter is swung upward by a spiral spring mounted upon the shaft between the lugs, as clearly shown in the sectional view, Fig. 2. Part of the top of the table is divided into small squares by which to gauge the paper to be cut.

The material to be cut is held firmly by the clamp bar, which is pressed on the paper by the screws. The operator seizes the handles of the shaft, and turns them so as to bring the blade down when the cutter is pushed from him; the blade, sliding along the guide edge, cuts off that part of the paper projecting beyond the edge.

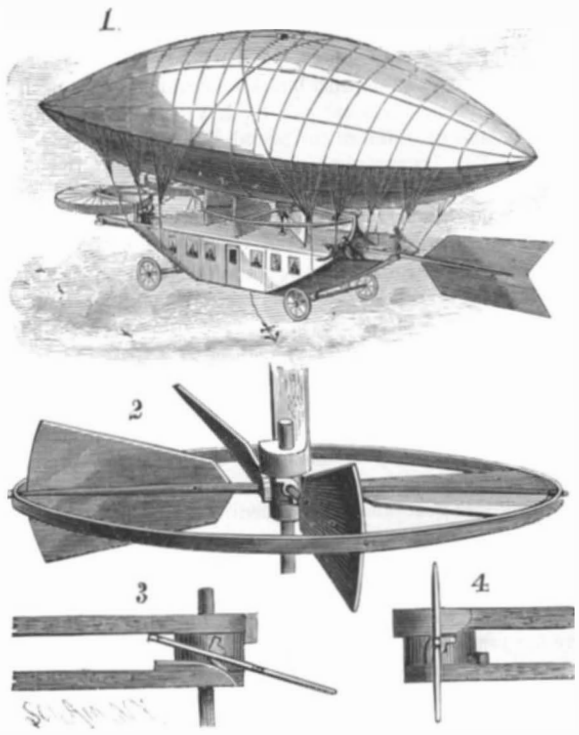
This invention has been patented by Mr. J. E. Tylee, and additional particulars may be obtained from Messrs. Tylee & Clarke, of Ashland, Neb.

American and English Colonies in Russia.

It is not generally known that there is an American town in the realms of the Czar, yet such is a fact, it being near Moreton Bay, Kamtschatka. The colony has been formed, gradually, by immigrants attracted by the establishment of important lumbering operations, including saw mills, by an American company, and the town itself, according to the *Zacht*, has so far been practically ignored. It is not down upon any known map, does not appear in the cadastral register, nor on any tax list. The consequence is that the inhabitants thereof pay no kind of tax, and, until recently at least, have remained independent of local authorities. Another colony, of English origin, of later establishment, but analogous origin, exists near Archangel, on the White Sea, where are important saw mills managed by capitalists of North Britain.

AN AERIAL PROPELLER.

The accompanying engraving represents an aerial propeller recently patented by Mr. M. H. Depue, of Homer, Ill. The propeller, Fig. 2, has a rim and hub in which are journaled radial blades; each journal of each blade being provided with two transverse arms in the same plane. The main



DEPUE'S AERIAL PROPELLER.

rudder for guiding and controlling the machine is shown in the right side of the perspective view. Upon each side, at the other end of the balloon, is a rimular rudder used to raise and lower the machine when balanced in the air, thereby avoiding the necessity of throwing out ballast or letting out gas. The under part of the balloon, next to the car, is made straight, thereby giving the propeller more power, and the car a better shape for the other attachments. When the car descends, it alights upon small wheels, which prevent scraping and sliding on the ground. Figs. 3 and 4 show the hub of the wheel and the frame and a single paddle or blade in different positions.

Real Disinfectants.

Professor De Chaumont, in a lecture at the Health Exhibition on cholera and its prevention, exposed the untrustworthiness of many so-called disinfectants. The belief in a few of these disinfectants has come to be almost a superstition, and it has been too much played upon by some sanitary authorities, and even medical officers of health, who in times of smallpox have covered all available hoardings in the parish with posters vaunting the epidemic virtues of disinfectants. Professor De Chaumont said: "In regard to

TYLEE'S PAPER AND CARD CUTTER.

disinfectants, there is but one true disinfectant, viz., fire. The majority of so-called disinfectants are simply deodorants. The idea that tobacco smoke or the odor of camphor is destructive of contagion is still extensively held, though it is simply absurd. A true disinfectant is a substance that will kill the germ or living particle in which the contagious principle resides, or through which it is conveyed."

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Rabies Inoculation.

It is now about four years since Pasteur commenced his experiments and researches into the nature of hydrophobia, the results of which have been recently given to the public. Although the profession and scientists generally may not be very sanguine as to the grand results which this distinguished *savant* claims, yet enough has been advanced to warrant the French Government in appointing a commission of scientific men of indisputable authority to investigate the matter and to test the value of the interesting experiments instituted by Pasteur. The names of Vulpian, Villemin, Bert, and Bouley are a sufficient guarantee of the character and reliability of the proposed inquiry. Pasteur in the course of his experiments hit upon the expedient of inoculating the brain of the animal with the virus of rabies. The skull is trephined with a small instrument, and the virus introduced.

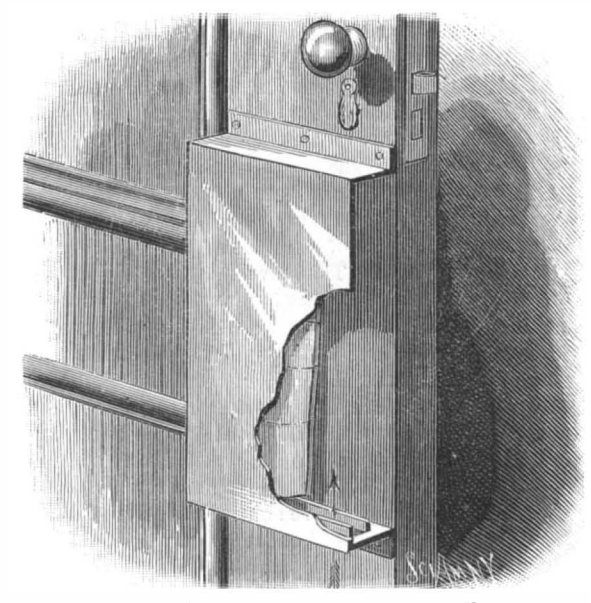
By this method the action of the virus is much hastened, the effects being manifest in a few days, instead of from twelve to fourteen days. In fact, Pasteur thinks he has in this way demonstrated that rabies is a malady of the brain. In the course of his experiments he found that the virus, after having passed through three monkeys in succession, becomes so attenuated that its introduction into a dog is harmless. But when the virus is passed through the rabbit and Guinea pig in like manner, it increases in virulence, becoming more virulent than the virus of the rabid dog. The plan proposed is to take the virus from a rabbit dying after inoculation, and inoculate this successively in other rabbits, and finally in the dog, which is thus rendered refractory to the rabies.

The test experiments proposed by Pasteur consist, first, in causing twenty unprotected dogs and twenty "vaccinated" dogs (presumably protected thereby from poison) to be bitten by dogs in a rabid state; and, second, in artificially inoculating with the virus of rabies two other sets of twenty dogs, respectively vaccinated and unvaccinated. "The twenty vaccinated dogs," says Pasteur, "will resist the poison, and the other twenty will all die of madness."

The importance of this discovery, if true, cannot be overestimated, but we must not be too ready, the Canada *Lancet* says, to express unqualified approval and indorsement of Pasteur's views. It will be observed that he uses, contrary to what one would have supposed, the virus from rabbits, and not the attenuated virus from monkeys. Furthermore, he does not propose to apply the virus for the protection of human beings, although we have read in the press that persons applied to him for inoculation. The experiments so far do not seem to us convincing, and we wait with considerable curiosity, mingled with not a little anxiety, the report of the commission. The result of these trials can hardly fail to be largely decisive of the question one way or the other, and will be an unequivocal illustration of the value of experimental pathology. Meantime, we agree with the man who said that the best way to prevent hydrophobia was "to shoot the dog before he went mad."

PAPER OR LETTER BOX.

A flat box having an open side and one of the longitudinal edges open is secured to the door in such a manner that when the door is closed the open edge of the box will rest against the side of the casing, which thus covers the opening. In the lower end of the box is a slot, the side edges of which are turned inward to form upwardly projecting flanges. When the door is closed the paper is pushed up into the box through the bottom slot, and as the edges of the paper distend after it has been pushed in, they rest over the flanges, thus making it impossible to pull the paper out of the box through the slot. The paper is thus secured until the door is opened, when it can be easily removed from the box through the side opening. The paper is thus protected from thieves and from the weather, and the box is simple in construction and cheap.



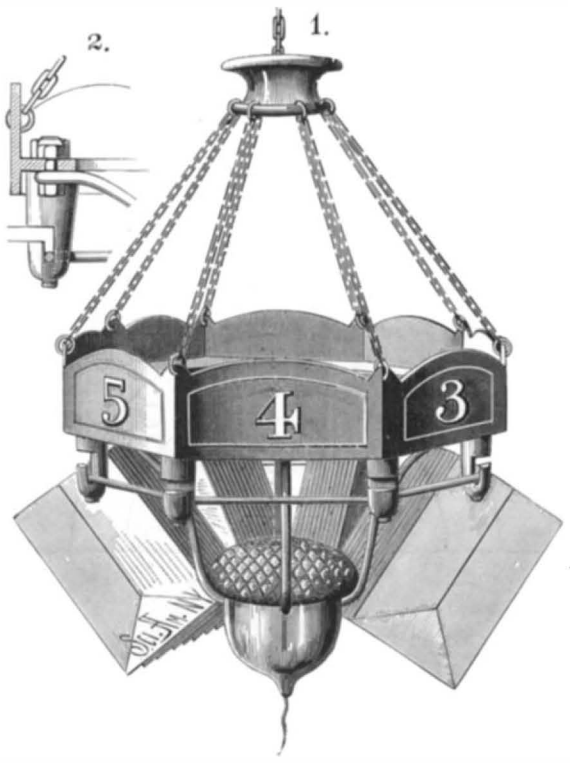
STOCKS' PAPER OR LETTER BOX.

This invention has been patented by Mr. Harry Stocks, and particulars may be obtained from Messrs. Campbell & Hanscom, of Lowell, Mass.

BAG AND TWINE HOLDER.

The bags are strung upon wires carried upon posts depending from a horizontal flange formed on the inner face of the octagonal ring. The wires are held to the parts by a hinge connection at one end of the wires, the hinges being formed by bending down the ends of the wires and passing these portions through holes in the lower ends of the posts, the pins being headed below the posts to hold them in place. The slots in the lower ends of the posts not only afford a means of connecting the hinge pins, but serve as guards to the pointed ends of the pins, which spring into the upper parts of the slots and lodge in the lower parts. The twine holder is made in the shape of an acorn and is attached to the ring by arms.

The cover is held in place by lugs on the lower portion,



GILLILAND'S BAG AND TWINE HOLDER.

which engage the inner edge of the cover when the slots in the cover—which pass over the lugs when the cover is put on—are turned around either way to carry the slots out of line with the lugs. Chains connect the octagonal ring to a collar which is fitted with a swivel hook, in the eye of which a chain is placed to suspend the bag and twine holder at a convenient height above the counter. Figures are cast or painted at the center of each plane face of the ring, to indicate the sizes of the bags held by the wires. In attaching the bags, the points of the wires are lifted from the slots and the bags strung on. The upper edges of the wires are made angular, to facilitate tearing the bags from them.

Further particulars relating to this invention may be obtained from the patentee, Mr. E. I. Gilliland, of Salt Lick, Pa.

Inventions Wanted.

Under this or similar headings the editor of the SCIENTIFIC AMERICAN has frequently called attention to inventions needed or to special manufactures for which there was a present demand.

There is hardly any field of invention which has been so little cultivated as the American house. For instance, what a disgrace it is to the mechanic arts in this country that every stick of timber in every house is not fireproofed by a cheap, practical process, the plant for which should become the second thing after a sawmill to be erected in every new settlement! For want of a cheap, practical process for fireproofing wood, one hundred million dollars' worth of property are destroyed ever year in the United States. The carpenters have hitherto opposed such processes because the mineralized wood is less easily finished with the common tools. But a large part of all the wood in a house is used in the rough, and this objection need not apply to it. For the finished wood let the fireproofing and steam seasoning be done together, after all the finishing has been completed except the final fitting. For the final smoothing, if edge tools will not work, let us have new tools, carrying pumicestone or other abrading and polishing material.

We are entering on a new and more complex system of domestic architecture—the family club house or social palace—which will require a host of new inventions. It is not looking very far ahead to see whole towns built in this way. These buildings must have their internal railways and elevators of all sizes. They must be tunneled for hot and cold air flues, ventilating flues, with artificial draught, steam, gas, water, and sewerage pipes, and speaking tubes. They must be equipped with an electric generator and electric wires for light, power, and telephony, with artificial refrigerating as well as heating apparatus, with gas generators, and the most perfect cooking and washing machinery. All of this machinery must be made on a large scale, with a capacity of subdivision.

There is, at the present moment, one desideratum in the modern house for which no sufficient provision exists, and which would insure a number of fortunes to the parties who would introduce the wished-for article in a cheap and practical form. This is a small elevator, run by the water in our city pipes, of no greater power than *fifty pounds raised ten or twelve feet*, applied to running the common dumb-waiter. This little simple invention would be a very important labor saving machine in the average house with a basement kitchen. It would save its own cost in broken crockery and servants' wages, not to speak of the temper of employers and employed.

There is room for a dozen manufacturers to advertise cheap, practical little elevators for this purpose in the SCIENTIFIC AMERICAN. Once introduced into our city houses, no house with a basement kitchen could go without it. The automatic dumb-waiter would have an enormous distribution.

WM. F. CHANNING.

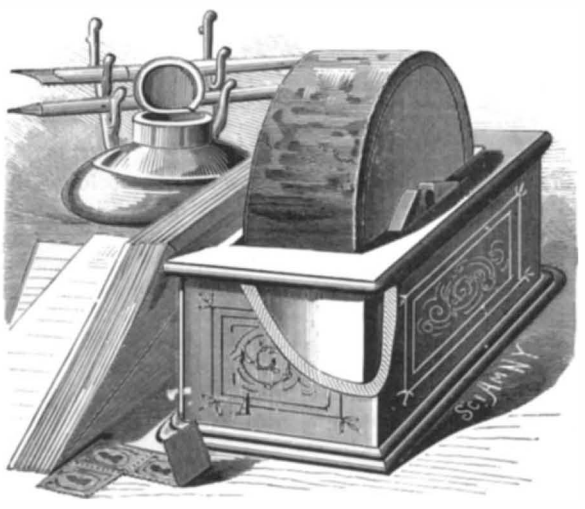
Taking Down a Chimney.

From a paper entitled "Chimney Construction," by Messrs. R. M. and J. F. Bancroft, we take the following interesting account of an ingenious arrangement employed for taking down a chimney shaft in Middlesboro', England, the method followed being necessary, as the chimney stood in a crowded position, and therefore could not be thrown down. The bricks had to be lowered with as little damage as possible, so that they might be used again for building purposes. Owing to the position of the chimney the bricks could not be thrown down outside, and if thrown down inside they would have been smashed, or if lowered by mechanical means the process would have been very tedious, and was impracticable. Under these circumstances it was considered whether the bricks could not be allowed to fall by their own gravity, and at the same time be cushioned sufficiently to break their fall and prevent damage. In order to do this an airtight iron box was placed at the bottom of the chimney; this box was fitted with an airtight door mounted on hinges, and closing on an India rubber face, against which it was tightened by a wedge.

A wooden spout was then fixed to the top of the box and carried up the chimney; it was 3½" x 5" inside, and was made of planks 1⅛" thick, well nailed together, with a little white lead on the edges, thus making it airtight. The spout was made in about twelve foot lengths, and these were joined together by cast iron sockets or shoes, and corked round with tarred yarn, the whole apparatus costing about $30. A few stays were put inside the chimney to keep the spout steady, and steps were nailed upon it, by which the men ascended. It will be seen that the whole of the spouting being airtight, if a brick filled the spout it would not descend; but as the section of a brick is 3" x 4½", and the spout was 3½" x 5", there was a quarter inch space each way through which the air could pass the brick freely, the space further allowing for any irregularity in the sizes of the bricks. The result was that the bricks, being cushioned in their fall, arrived at the bottom without any damage. As soon as the box was full the man at the bottom rapped on the spout as a signal to stop, and then opened the airtight door and removed the bricks inside. This being done he shut the door and signaled same to the man at the top. The man on the top lowered his own scaffold, and as the spout became too high he cut a piece of with a saw. If there was much mortar adhering to the bricks, it was knocked off before putting the latter into the spout, and such mortar, etc., was allowed to fall inside the chimney, and was afterward wheeled out.

STAMP AND ENVELOPE MOISTENER.

The engraving shows an apparatus for moistening stamps and adhesive envelopes that was recently patented by Mr. D. G. Beaumont, of Laredo, Texas. A box made of any desirable material and of convenient form may be adapted to contain water, or may be provided with a removable water reservoir. The cover is formed with an oblong aperture to receive a wheel upon whose periphery is a covering of cloth or other suitable material which dips in the water in the reservoir. After revolving the wheel so as to saturate the covering with water, the stamps are moistened by pressing them lightly against the covering; this plan avoids the inconvenience of moistening them with the tongue, and also removes very little of the gum.



BEAUMONT'S STAMP AND ENVELOPE MOISTENER.

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The Excavation of a Great Cut in France.

The railroad from Saumur to Chateau-du-Loir, after leaving the valley of Loire, crosses an elevated plateau by a cut 1,640 feet long and with a maximum depth of 62⅓ feet; the cubic contents equaled 274,500 cubic yards.

The material belongs to the Tertiary period, the Eocene; it is made up of a bed of clay inclosing large bowlders of a pudding stone formation, lying in distinct strata, about 17 feet thick; under this is a bed of white clay, 29½ feet thick, traversed by small veins of sand; beneath this again is sand.

The method of removal adopted was as follows: A gallery or tunnel was driven into the cut at its base, and this tunnel was connected at intervals with the surface of the cut by vertical shafts located on the axis of the cut. These wells were then enlarged from the top by giving them a funnel shape, and the material thrown directly into the cars placed beneath, at the bottom of the shaft. The tunnel was driven from both sides.

The tunnel was timbered as in a mine; two posts and a cap of oak 10x10 inches, spaced about 5 feet apart, with lagging of poplar planks 10x1½ inches and 6¼ feet long. The gallery was $7\frac{8}{10}$ feet high and 11½ feet wide in the clear.

While the tunnels were being driven, the wells were also sunk. At the bottom of the wells the caps of the tunnel-timbering were tied together longitudinally by braces spaced 3⅓ feet apart, thus forming a kind of box and strengthening the upper part of the gallery; four of the covering planks covered this space.

As soon as the wells were finished and the tunnel driven, the removal of the material commenced. The workmen began by breaking away the earth at the top of the shaft by bars and throwing it into the opening. As soon as the slope of the cone thus formed became too flat to permit the free motion of the debris, the cone was deepened so as to present a steeper pitch. One man in the gallery was all that was required to regulate the fall of the earth into the cars. At this cut only two wells were worked at a time; this was sufficient to furnish a cube of 600 cubic yards daily. By this method timber was saved, and the tunnel advanced by reusing that from the portion of the cut finished.

The train of empty wagons was drawn in by three horses, and the horses and their driver were prisoners in the tunnel heading while the filling was going on, but as no relays of horses were thus required, an interval of rest was afforded. The loaded cars descended by gravity to the dump by reason of the grade of the road.

In this method of excavating, it is advantageous to have cars as large as possible so that they may be less frequently moved; at the cut in question the cars contained 4¾ cubic yards and ran upon a track of 5 feet gauge. As each movement of a car corresponds to a stoppage in the excavation, as soon as the bed of sand was reached the engineer, to avoid the loss of time from this cause, put a stop valve at the bottom of the well.

The valve was made by placing upon a timber framework a sheet iron cylinder 2 feet in diameter, closed at the bottom by an iron door, like that used on a beton mixer. This door moved horizontally in guides, and was pivoted at one side.

When the successive funnels met at the top, a series of cone-like excavations of great width were presented, and it only remained then to cut down and remove the walls of earth lying between the cones.

The cost of the timber for 1,200 feet of tunnel, including the timbering of the shafts, was $782,

The manual labor and expense of driving the tunnel amounted to $1.83 per lin. foot. The total expense was as follows:

Timber for tunnel and shafts	$782.00
Labor and tunnel advance, @ $1.83x1200	2,196.00
Sinking 4 wells at $20 (100 frs.) each	80.00
	$3,058.00

Dividing the total cost by the contents of the cut, 274,500 cubic yards, we have as the cost per cubic yard about 1·1 cents (0·074 fr. per cubic meter).—*Genie Civil; Engineering News.*

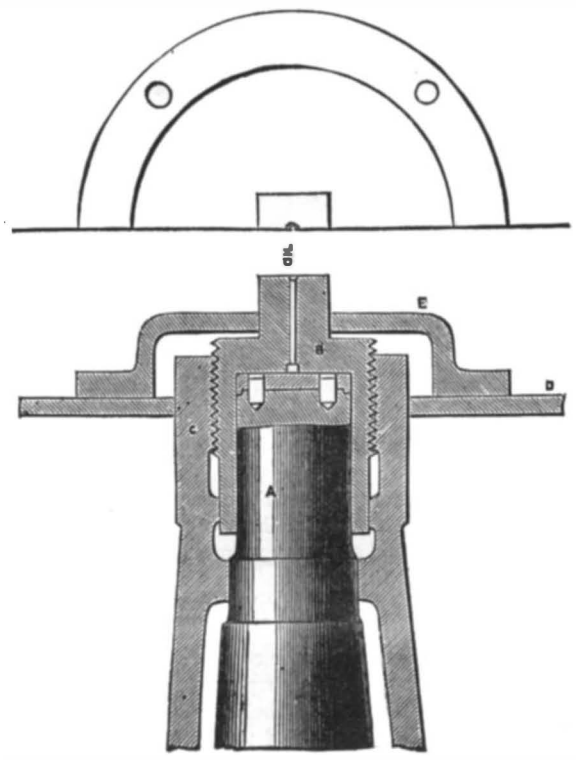
Painting Shingled Roofs.

More shingle roofs are painted now than ever before in the history of building in this country. It is mostly seen in cities and suburban towns, although in the country it is by no means rare. Considerable inquiry has led to the conclusion that many have their roofs painted to add to their appearance, which in many cases it certainly does, while others labor under the impression that the paint acts as a preservative to the shingles. The latter are probably right, provided the paint is renewed as often as it needs to be. If the roof is allowed to remain with the paint partly worn off the shingles will retain more moisture, and consequently decay sooner then they would were they not painted at all. On the score of durability, however, little can be gained in cost by painting. A good shingle roof unpainted will last a great many years, and the expense of painting it a few times would replace it. One painter, who had painted the roof of his own house, when questioned by a representative of the *Lumberman*, used good logic from his standpoint. He thought that painting a roof would add somewhat to its length of life. "You see," he said, "that I have painted mine. I do for myself what I desire to do for others. If I did not, the influence would be bad."

FOURTEEN TON LOCOMOTIVE CRANE.

(*Continued from first page.*)

post and bearings. The post is a wrought iron forging, A, fixed in the carriage, with a bearing at top and bottom, on which the crane revolves. The weight is carried on a steel plate fixed on top and the steel bush, B. This bush is screwed into a jacket or case, C, which is continued down to the bottom bearing. The post is thus entirely inclosed, and no dust or grit can find access to the bearings. There is a square head on the bush, to which is fitted a large cap, E, fixed by four bolts to the cross girder, D, which is a wrought iron plate. The bush can be adjusted by screwing it in the case to maintain the crane at a constant level above the carriage, taking up any wear. It can also be removed and replaced for inspection or cleaning in a few minutes. On unscrewing the bush the crane settles down about a quarter of an inch lower than the working level, and rests on the carriage till the bush is replaced. The side frames are of massive proportions, with brass bushes and covers for the various bearings of the shafts. There is a large balance weight of 8 tons under the boiler, with ash space and self-discharging arrangement. The boiler has two cross tubes in the fire box, and is double riveted in the vertical landings. A capacious tank is carried on the opposite side to the platform. The engines have a pair of 8 inch cylinders, with link reversing motion of steel. The crank shaft is balanced by weights to prevent vibration. The disengaging



CRANE POST AND BEARINGS.

clutch for hoisting is in the view of the driver on the platform, and there is a powerful foot brake for lowering.

The jib is 22 feet 6 inches long, of wrought iron, with lattice stays, and is adjustable by worm and wheel motion. The handles are all convenient to the driver, who has easy control of all motions, viz., hoisting, lowering, slewing, traveling, and adjusting radius. The weight of the crane is 41 tons, exclusive of water in the boiler or tank; the center of gravity of the whole is as even as possible to obtain maximum stability. The greatest radial projection at the back is 7 feet 9 inches.

Saccharification of Different Starches.

In spite of all that has been written and said concerning the saccharification of the different starches since brewers have been allowed to use unmalted grain in their mash tuns, there is still, says the *Brewers' Guardian*, much difference of opinion, and the practical applications of theoretical opinions have not always been attended with success. In dealing with the conversion of starch into sugar, the fact has frequently been overlooked that starches vary very considerably; the starch of barley is in many respects different from the starch of maize, and the starch of rice differs from both; this difference is not in the chemical composition, for all the starches are identical in this respect, but in their physical properties; the size and aggregation of the different starch cells have a most important bearing on the problem which has engaged so much of the attention of brewers of late. From the following table it will be seen how greatly the cells of the starches vary in size; the dimensions are given in decimals of an inch.

Potato	0·00270 to 0·00148
Maize	about 0·00074
Dari	" 0·00074
Wheat	0·00185 to 0·00009
Barley	about 0·00073
Oat	" 0·00037
Rice	0·00020 to 0·00002

It will thus be seen that the sizes of starch cells vary between very wide limits, and it has been established by some experiments of Symons and others that the smaller sized starches resist the action of moist heat much more than the larger ones; the cells of potato starch, for instance, tumefy and burst at a temperature several degrees below those of rice starch; this question of the tumefaction of starches has a very important bearing on their saccharification, and scarcely sufficient attention has yet been paid to the subject. The larger the starch cells, the more compact and dense are their cell walls, and thus the greater is the resistance to the disintegrating influence of heat; diastase, also, has comparatively little action on the outside of the starch cells; the cells must be burst or broken, so that the diastase can penetrate into the interior for this agent to exert its full saccharifying action. If this view be correct, the difficulty of conversion of the starches must be in direct proportion to the sizes of the cells, and the experience of practical men will probably confirm this, for although rice is a brewing material which presents many advantages as regards price and purity, it is not saccharified with the same ease as maize or potato starch, unless previously submitted to some treatment by which its starch cells are ruptured. Before the solution of this problem can be satisfactorily effected, the physical as well as the chemical properties of starch must be taken into consideration, and it is in this direction that further investigation is needed.

Gerome Cheese.

The following is a description of the manufacture of a very popular cheese, known in France under the name of Gerome. It is largely consumed in Paris just as it is ripe, and it would be difficult to mention any cheese which is more delicious at this particular period. It is a soft round cheese, varying in weight from 4 pounds to 8 pounds, and is sometimes made with the addition of aniseseed. It is made with milk at the temperature at which it comes from the cow, this being placed in a deep copper vat holding some forty-five quarts, when it is covered with a wooden lid, in the center of which is inserted a wooden funnel resembling in form a cup. To the bottom of this is attached a cloth for straining. When this is not used, a small disk is drawn over the hole. The rennet is immediately added, in quantity according to the weather and its strength.

In half an hour the whey is divided from the curd with a ladle, and the vat recovered. In another half hour the separation is continued, with the aid of a copper strainer, 12 inches by 4 inches. When the curd is divided into pieces about the size of a small nut, it is taken out and placed in wooden cylindrical moulds, from 5 inches to 9 inches in diameter. Two moulds are used for each cheese, the one being fixed into the other, which is somewhat larger in diameter, and has a number of holes pierced in the bottom. The total height of the two when fixed is from 14 inches to 16 inches. The curd entirely drains in this mould, and at the end of about twelve hours it will have sunk to about the height of the bottom and larger part of it, so that the top part can be taken off. The cheese is then placed in another mould of the same diameter as the bottom one, and put upon a shelf upside down. After six hours it is again turned, and this turning is continued twice daily for the two following days.

In draining the whey the moulds are placed upon sloping shelves, which are furnished with a rim at the edge, as in the Camembert cheese rooms in Normandy. The whey runs off, and is collected in a receptacle placed at the side of the table for the purpose. The temperature of the room in which this operation takes place should be from 59° to 64° Fah. The next thing to be done is to salt the cheeses, which for this purpose are placed upon small boards made of beech, and upon which layers of fine salt are sprinkled. The surface of the cheese must be well salted, and the operation repeated every three or four days, care being taken that it is turned each time. This turning is continued twice daily for three days after salting, and the surfaces of the cheeses each time are gently moistened with tepid water. When sufficiently dry on the crust they are removed to the drying room, 30 grammes of salt having been used in the salting process. In this *sechoir*, or drying room, the cheese shelves are built one above the other, so that large numbers of cheeses can be kept in a small space and well cured, provided the temperature and aeration are complete. In summer the process of ripening is frequently conducted in the open air, the cheeses being protected with cloths to keep off flies and the sun; but during the other parts of the year a specially prepared room is invariably used.

When thoroughly dry they are removed to the cave or cellar for the completion of the process, and here they are very carefully managed. This cave must be in good condition, with a draught of air passing through it; but if the temperature is too low, the cheeses crack and lose quality. The time they remain here is determined by the season and the size of the cheese, the maker judging this for himself. The largest, however, are usually kept from three to four months. While in this compartment they are often turned, and washed with tepid water slightly salted, and daily examined to see whether they are ripening too rapidly. When they are brick-red in appearance and the surface sufficiently firm to yield to the pressure of the finger, they are ready for market. A good Gerome is firm on the exterior, rich, and oily, and has a few small holes in the interior; while inferior makes, like inferior Gruyere, have numbers of large holes, are fragile, easily crumble, and sometimes become soft and pulpy when the whey has not been properly extracted from them.—*London Grocer.*

Platinized Magnesium.

M. BALLO.—Magnesium, which has no action upon pure water, decomposes it instantly in presence of a trace of platinum chloride.—*Zeit. f. Anal. Chem.*

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Correspondence.

Lightning for Diamond Making.

To the Editor of the Scientific American:

I notice in your issue of July 26 that a correspondent of *English Mechanic* proposes to utilize lightning for the purpose of manufacturing diamonds, but has failed thus far on account of the scarcity of lightning strokes in the locality in which his apparatus has been erected.

Will you please inform the gentleman through your paper that I can show him a place where lightning strikes on an average once a year; at least it has done so for the last four years, keeping within a radius of two hundred yards from my house.

An annual yield of half a bushel or so of diamonds will amply repay all expenses of moving and resetting the apparatus. No charges made for this information; a donation for the rebuilding of my school, destroyed by lightning a couple of weeks ago, will, however, be thankfully received.

PETER J. DESMEDT,
Pastor of St. Mary's.

Cheboygan, Mich., July 28, 1884.

Work of a Small Engine.

To the Editor of the Scientific American:

We have in our mill a direct-acting engine, 10″ x 12″ cylinder, which was fed last season from a small boiler, 40″ x 10′, thirty-two 3″ flues, with a steam dome, 24″ x 3′. This engine runs a 60 inch saw, with 80 to 90 pounds pressure, 450 to 600 revolutions per minute, cutting 20,000 feet of elm per day; size of steam pipe, 2½″; size of exhaust, 8″. The exhaust from this engine was fed into steam boxes, making an estimated back pressure against it of 50 pounds. The same engine is fed this season with the same sized pipe from a larger boiler, and is doing even better. It is commonly run up to 600 revolutions per minute, as tested by the speed indicator. The reason of our putting in a larger boiler was to get additional steam for another engine, not because we found the other boiler at all inadequate. The manner of fitting a saw has a great deal to do with the power of an engine; poor fitting will choke an engine down as quick as anything.

F. H. S.

Trenton, Mich., August 4.

[The statement of F. H. S. seems rather extravagant—600 revolutions per minute with 80 or 90 pounds steam, with 50 pounds back pressure, leaving 30 to 40 pounds only as utilized, cutting 20,000 feet of elm per day. Who will add their experience to this?—ED.]

The Registration of Labels.

To the Editor of the Scientific American:

An intelligent discussion of any controverted point in the statutes which the Patent Office is required to administer is always of interest and value to us who are employed in the office, as well as to the public, to whom presumably such discussions in the columns of the SCIENTIFIC AMERICAN are addressed. I have therefore read with interest two articles which you have recently published criticising the action of the Commissioner of Patents in refusing to admit to registration, under the act of June 18, 1874, labels which in his judgment constitute trade marks. It is none of my business to defend one so well able to take care of himself as the present Commissioner, and yet for the information of the public there are some things not yet stated in your valuable columns which in fairness ought to be exhibited as elements in the determination of the question whether he is right or not in the position he takes.

I therefore venture to ask you to print the full text of the section of the law whose interpretation is in question, and which is as follows:

"SEC. 3. That in the construction of this act the words 'engraving, cut, and print' shall be applied only to pictorial illustrations or works connected with the fine arts, and no prints or labels designed to be used for any other articles of manufacture shall be entered under the copyright law, but may be registered in the Patent Office. And the Commissioner of Patents is hereby charged with the supervision and control of the entry or registry of such prints or labels, in conformity with the regulations provided by law as to copyright and prints, except that there shall be paid for recording the title of any print or label, *not a trade mark*, six dollars, which shall cover the expense of furnishing a copy of the record, under the seal of the Commissioner of Patents, to the party entering the same."

I agree with you that there is room for doubt as to the constitutionality of this law; but with that the Commissioner has nothing to do. As long as no court having authority has pronounced upon the question, and the statute stands unrepealed, he must administer it in the interest of the public, interpreting it in accordance with his best judgment.

He may employ such means as he finds best to guide his judgment, may seek the aid of counsel, may endeavor to procure the determination of courts, but no law can be so framed as to take away from the executive officer to whom it is committed to administer, all exercise of discretion.

Now I think no one can read carefully the above section without observing that some discretionary power is conferred upon the Commissioner.

He is charged with "the entry of such prints and labels in conformity with the regulations provided by law as to copyright and prints," but the statute goes on to particularize, that prints and labels *such as are not trade marks* are the only ones provided for under it.

Now, as you say, "a trade mark is defined by law, a label is not." That readers may not be misled, it is as well to say here, that when you say defined "by law" you do not mean *by statute*, at least in the United States. What constitutes a trade mark is determined by a thousand decisions and rulings of the courts; and, unfortunately perhaps, there is not a single decision or ruling of United States courts, so far as I am aware, out of which a legal definition of a label can be derived.

Still, a trade mark being well defined, it can be easily apparent to the Commissioner, when a case is presented to him, whether it is a trade mark or not. No legal definition of a label is needed to guide him in this question, and being, as he interprets the statute, inhibited from registering any labels but such as are not trade marks—trade marks within the well known definitions—it appears to me that when he refuses to register any label because in his judgment it amounts to a trade mark, he is simply exercising the discretion which the statute intends he shall exercise.

The Willcox & Gibbs case, which you cite in your article of Aug. 9, was a suit for *mandamus*. Legally it settled the status of the particular case, and no other. The Commissioner has never been legally bound by it.

The late Commissioner thought best to be guided by it; the present Commissioner does not. I think I may venture to say that he will be perfectly satisfied to have a case carried up to the Supreme Court of the District of Columbia, where it will be properly argued by counsel on his behalf (as the Willcox & Gibbs case was not), and even to the Supreme Court of the United States, for a final determination of the meaning of what has already been the most obscure statute with which the office has had to deal.

The public can hardly be aware of the confusion and conflict of rights resulting from the practice upon which you insist, but the office is painfully aware of them, and under constant embarrassment in consequence of them. The position taken by the Commissioner is the only one now seen by which this confusion can be prevented; and unless it is desired that the office shall be kept in hot water by the issue of papers which, whatever their actual value, are employed as conflicting evidence of title, he should be sustained in the interest of honest trade and fair dealing.

Very truly yours,

F. A. SEELY,
Examiner of Trade Marks.

U. S. Patent Office, Aug. 9, 1884.

The Label Registry Statute, as we may term it (Sec. 3, 4, and 5, Act of June 18, 1874, referring to patents, trade marks, and copyrights), is characterized by our learned correspondent as obscure. Such being admitted, it would seem proper to use in its interpretation any light afforded by the courts. In the decision in the case we cited—the Willcox & Gibbs Sewing Mach. Co. *vs.* E. M. Marble, Com.—the statutes are so clearly explained and defined that to our minds it seems that further light is not needed. This case treats the question in the broadest possible way. Of course, all the decision did "legally" was to determine the issuing of the final mandamus. The three judges then sitting discussed the question in so full a form, and yet so concisely, that it is an injustice to quote fragments of the decision. We will quote enough, however, to show that it "practically" should settle, as far as the office is concerned, the status of all this class of cases.

"Of course, then, when this control over the registry of the same prints now called 'labels which are not trade marks' was transferred to the Commissioner of Patents, it had only the same limited application, and did not include any discretion to determine whether a particular label should be classed as a trade mark or as only a label. If Congress had intended to take away from the owner of a label his former right to determine what use he should make of it and how he would have it entered, that intention would have been plainly expressed. The actual intention was merely to change the place of registry. When an applicant for registry complies with all the requirements of the law and the lawful regulations, as the relator appears to have done, the function of the Commissioner is merely ministerial."

If the Willcox & Gibbs case was not argued properly by counsel, it would make little difference before such a tribunal as the District of Columbia Supreme Court. The three judges were well able, *sua sponte*, to investigate all the law relating to the case. In admitting trade marks to registration an examination is required to see that they comply with the law, scattered through many decisions, as our correspondent observes. This examination is a source of expense to the office, and is provided for in the fee ($25) charged for registration as trade mark. In registering labels no examination is authorized, and this seems indicated by the much lower fee ($6) charged for label registration.

The courts have been prolific in decisions on trade marks; the common sense interpretation of the statutes makes such definition of labels uncalled for. The Willcox & Gibbs decision gives an abler and more concise statement of the matter than we could pretend to, so we do not feel called on to argue the case at length. At present the Hon. Commissioner of Patents simply refuses to accept the opinion of the Supreme Court, deliberately expressed, as of weight in affecting his action. Finally, we beg leave to tender our thanks to our correspondent for the courteous manner in which he has criticised the two articles.

Conductivity of Metals and Alloys.

M. Lazare Weiller has conducted a new and independent investigation into the electrical conductivity of certain metals and alloys, the results of which he lately presented to the Society Internationale des Electriciens. For the purposes of his experiments he caused small bars of metal to be cast of a diameter of about 13 mm. (0·51 in.). These were divided in such a way as to show the grain of the fracture, and one part was drawn into wire to be used in the trials. Those alloys which can neither be drawn nor rolled easily, such as silicides and phosphides, were tested directly on the cast bars after the method of Sir William Thomson. In the trials the bars, fitted with binding screws at each end, rested upon knife edges at an invariable distance apart. These knife edges were respectively in communication with two resistances composed of two parts, of which the one was a thousandth part of the other. The extremity of one was connected to the fixed terminal of a Wheatstone bridge with a sliding contact, and the other to the slider itself.

The two points which separated the resistances communicated with the galvanometer. Finally the extremities of the bridge were connected to the binding screws by means of a circuit, which included a battery of four elements and a contact key.

The resistance sought was then equal to the resistance measured upon the wire of the bridge, divided by 1,000. The measurements, which were very carefully and accurately conducted, and were effected on a great number of specimens, were made in part by M. Weiller himself, and in part by M. Duflon, in the laboratory of Messrs. Breguet. The results are given in the following table:

1. Pure silver	100
2. Pure copper	100
3. Refined and crystallized copper	99·9
4. Telegraphic silicious bronze	98
5. Alloy of copper and silver (50 per cent)	86·65
6. Pure gold	78
7. Silicide of copper with 4 per cent of silicium	75
8. Silicide of copper with 12 per cent of silicium	54·7
9. Pure aluminum	51·2
10. Tin with 12 per cent of sodium	46·9
11. Telephonic silicious bronze	35
12. Copper with 10 per cent of lead	30
13. Pure zinc	29·9
14. Telephonic phosphor bronze	29
15. Silicious brass with 25 per cent of zinc	26·49
16. Brass with 35 per cent of zinc	21·5
17. Phosphor tin	17·7
18. Alloy of gold and silver (50 per cent)	16·12
19. Swedish iron	16
20. Pure Banca tin	15·45
21. Antimonial copper	12·7
22. Aluminum bronze (10 per cent)	12·6
23. Siemens steel	12
24. Pure platinum	10·6
25. Copper with 10 per cent of nickel	10·6
26. Cadmium amalgam (15 per cent)	10·2
27. Dronier mercurial bronze	10 14
28. Arsenical copper (10 per cent)	9·1
29. Pure lead	8 88
30. Bronze with 20 per cent of tin	8·4
31. Pure nickel	7·89
32. Phosphor-bronze with 10 per cent of tin	6·5
33. Phosphor-copper with 9 per cent of phosphorus	4·9
34. Antimony	3·88

The resistances are not given in ohms, but as proportions to a given body. They may be reduced to the conventional standard on the assumption that a wire of pure silver, one millimeter in diameter, has, at a temperature of zero Cent., a resistance of 19·37 ohms per kilometer.

A New Domestic Machine Wanted.

We are all of us too apt to forget past annoyances in protracted but temporary exemption from them, and yet what has been will be again, with many inconveniences at least, especially those which are peculiar to the different seasons. The severity of last winter, however, must be fresh in the memories of most of us. The frequency of snow falls, and the necessity and expense of clearing off the sidewalks in front of our domiciles, made many a good housewife's heart ache, and the numerous annoyances, dangers, and accidents to pedestrians, consequent upon the accumulation of snow and ice on our street pavements, were too forcibly brought to our notice or experience to be very easily forgotten.

Here then, we think, is a field for new and profitable invention, and the man who can devise a good and cheap machine for removing the snow and ice from in front of our dwellings and stores would be a public benefactor. All previous attempts employing heat have been failures. What is needed is a good hand machine that can be manipulated much in the same manner as a carpet sweeper or a hand lawn mower, and which can be readily used by any ordinary domestic. Something more than a mere brush or scraper would be requisite, but such a machine need not necessarily be very complicated. We are tired and ashamed of those clumsy expedients now in use, the shovel and the crowbar, and have often wondered why more efficient and economical means could not be discovered.

If a cheap and serviceable machine, such as we have here indicated, can be invented, there is money in it; but whoever would try to bring out an implement of the kind should not leave it till the winter is on us again, but at once proceed to make the effort and have his invention patented and his machines, in sufficient quantities, in the hands of the dealers in time to meet the coming winter's demand; and this would not be confined to a single place, but would apply to every city afflicted with snow and ice during no inconsiderable portion of the year.

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DELTA METAL.

Mr. T. A. Crompton, chief engineer of the steamer Assyrian Monarch, has recently shown us some specimens of this new alloy, which is stated to possess a number of valuable qualities. In color it resembles gold. The following are some of its qualities as claimed by its inventor and manufacturer (Mr. Dick).

Delta metal can be forged and rolled *hot*, and when so treated is 50 per cent stronger than wrought iron. In its molten state it runs freely, and sound, close-grained castings can be produced from it. When cold it may be *rolled* into the thinnest of sheets, or drawn into the finest wire, its tensile strength in the latter form being nearly three times that of the best wrought iron. It is adapted for all kinds of cylinders, cocks, valves, and other steam fittings; being grainless, it is easily manipulated by any cutting tool, will take a high polish, and does not tarnish or corrode.

Its quality of non-corrosion renders it specially suitable for air, circulating, feed, and bilge pump rods, linings, buckets, valves, rams, condenser tube plates, studs, and bolts, or anything exposed to the action of salt or fresh water. For screw propellers, its great tensile strength and non-liability to flaw or breakage in cases of fouling wreckage, or such like, will render it invaluable, its nature being that of bending to a blow long before fracture can take place; and by its great superiority in hardness, toughness, and ductility over cast iron, gun metal, or brass, propellers may be made much lighter in weight, and their blades much thinner at their extremities, and shaped to finer and quicker curves and bends, in "Delta metal" than in any other now in use.

A great future is open to this metal, its qualities before enumerated making it less liable to damage by indenting than other metals; and its power of resisting corrosive action, combined with its lesser required thickness for the same strength, points to its special adaptation for purposes where the transmission of either heat or cold—as in stills, refrigerators, fresh water or surface condensers, land and marine boilers, etc.—is a desideratum.

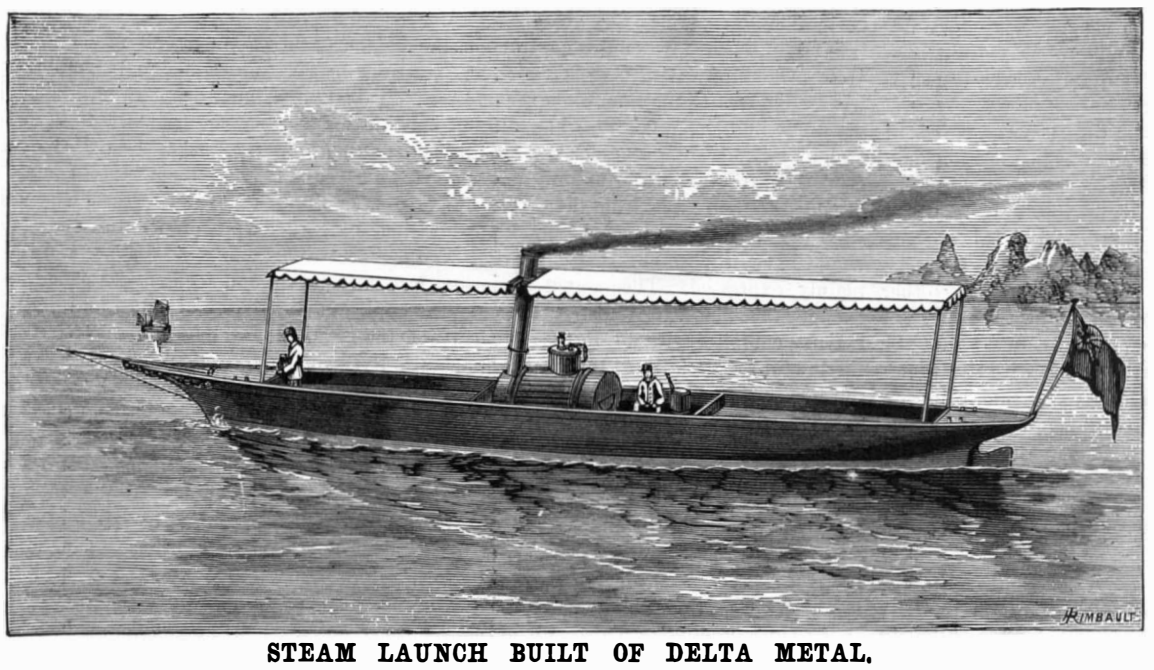
Outside the more direct uses to which this metal may be put by the mechanical, marine, hot water, gas, or electric engineer, or shipbuilder, its possible applications are truly "legion" in number, as there is hardly anything made of metal, either inside or outside our factories, shops, offices, or houses, or in our streets, which may not be fashioned out of it.

From the results of experiments made to ascertain the comparative tensile strengths of Delta metal, brass, and gun metal:

Delta metal, cast in sand (green), showed a breaking strain of	21·6 tons per sq. in.
Ditto, rolled hard (1½ in. diameter bar)	33·6 " " "

Among recent applications of the new metal is its use for small vessels, such as steam launches. We give an engraving of such a boat constructed entirely of the Delta metal by Messrs. Yarrow & Co., of Poplar. The length of the launch, which is named the Delta, and is at present at the Crystal Palace International Exhibition, is 36 feet over all, with a breadth of beam of 5 feet 6 inches, and a depth from gunwale to keel of 3 feet, and she will conveniently seat twenty-five persons.

Delta metal is an alloy of copper, zinc, and iron; having repeatedly been proved of equal strength, ductility, and toughness to mild steel, the plates and angle pieces were made of the same thickness as if steel had been used, viz., three thirty-seconds of an inch. The stem, keel, and stern post are of forged Delta metal, and are scarfed together in the usual manner The angle frames, of the same material, are placed longitudinally instead of transversely, so as to obtain greater longitudinal strength. The four bladed screw propeller is cast in Delta metal, and has a diameter of 2 feet 4 inches, with a pitch of 3 feet. The engine, of the usual direct-acting inverted type, is of sufficient power to give a speed of eight knots per hour.



STEAM LAUNCH BUILT OF DELTA METAL.

Terrors of Lightning.

Nathan Miller, of Maryville, Kan., lost his four daughters, aged respectively 18, 17, 9, and 7 years, by a single stroke of lightning.

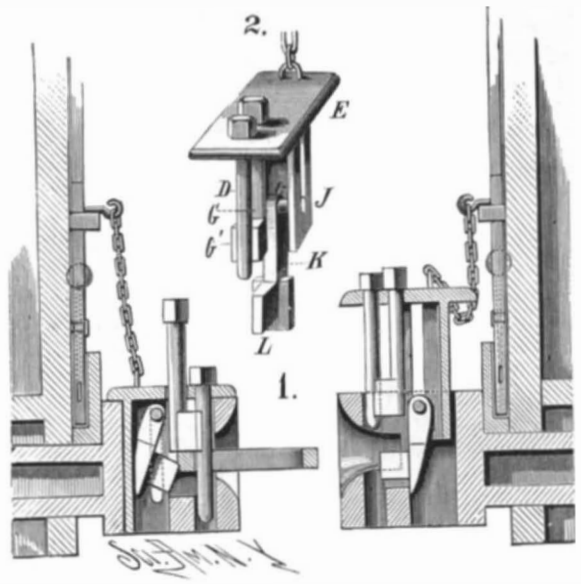
Lightning struck the house of John Queen, of Jacob's Creek, Pa., knocked from the wall his loaded gun, and at the same instant his daughter Nancy dropped dead. The gun was discharged, and the contents struck her in the breast. Whether she met her death by the lightning or the shot will never be known.

ONE hundred and five miles in 119 minutes, or almost 52 miles per hour—deducting stops, 55 miles per hour—was the time lately made by a special passenger train on the Illinois Central Railway, being from New Orleans to McComb City.

CAR COUPLING.

Near the outer end of the draw head is formed a vertical hole, for receiving the coupling pin, D, which is passed through a hole in the plate, E, on top of the drawhead. Behind this hole is a second one for receiving a downwardly projecting bar, G, having an enlargement at its lower end. Behind these is a third aperture extending from top to bottom and containing a hollow slide, J, projecting downward from the plate to which it is fastened. Pivoted on a transverse pin that passes through vertical slots in the sides of the slide is the latch, K, formed with an outwardly projecting tongue, L. A vertical sliding rod is held by clips on the end of the car and is connected by a chain with the plate, E. This rod is operated by two levers pivoted to the ends of the car and passed through a vertical slot in the rod.

When the car is to be coupled the plate of that draw head which is to receive the link is raised by pulling up the rod,



HOOVER'S CAR COUPLING.

either from the top of the car or by means of one of the levers. When the plate is moved the latch swings outward, the tongue passing into a slot connecting the holes and holding up the plate, the hollow slide, the bar, and the pin. When the link enters it pushes the latch inward, thereby permitting the parts to drop, the coupling pin passing through the link. The bar, G, rests on the inner end of the link, and is of sufficient weight to hold the outer end of the link raised so that it will be in a horizontal position. To uncouple the cars the plate is raised by pulling up the vertical bar or by operating one of the levers.

This invention has been patented by Mr. G. W. Hoover, of Keithsburg, Ill.

Efficiency of Lightning Rods.

Prof. Mohn, of Christiania, Norway, having been employed by the government to investigate the efficiency of the protection afforded to buildings by lightning rods, seems to have substantially settled the much debated question, at least for that region of country. His report shows that lighthouse, telegraph station, and other exposed buildings, which were provided with conductors, did not by far suffer as much as churches, which in most cases were unprotected. It appears, in fact, that of about 100 churches reported to have been struck by lightning, only three were provided with conductors; that of these three the first had a conductor in good order, and the building was uninjured; the second had a conductor of zinc wire, which melted, and, of course, left the structure without protection; the third had a wire which was rusty where it joined the earth, and the church was burned. More than one-half the number of churches struck were totally destroyed. Mr. Preece, the English government electrician, states that no damage has occurred to telegraph poles since the practice was adopted of providing them with lightning rods or earth wires.

A New Saltpeter Bed.

To the eastward of Cocha-bamba, in Bolivia, South America, an immense saline deposit has been discovered near the village of Arane. Analyzed by M. Sacc, the ingredients are potassic nitrite, 60·70; borax, and traces of salt and water, 30·70; organic matter, 8·60 per cent. On dissolving this mixture in boiling water and cooling it, a plentiful crystallization of pure saltpeter is obtained. The soil on which the bed lies is brown and inodorous when it is dry, but when moistened it gives out an odor of carbonate and sulphydrate of ammonia. M. Sacc has found it composed of incombustible residue, 74·20; borax and salts, 15·50; and organic matter with water and ammoniacal salts, 10·30 per cent.

The incombustible residue is formed of a very fine sand, and of phosphate of lime, magnesia, and iron in large proportion. The saltpeter has evidently originated from the oxidation of the ammoniacal salts of the soil in presence of potash and soda produced by the slow decomposition of the schists on which they rest. The potassic nitrate has mounted by capillarity to the surface of the soil, while the deliquescent nitrate of soda has been drawn by the rains toward the dry and warm regions of the coast, where it forms the beds of nitrate of soda actually worked in Chili. As immense quantities of fossil bones are found in the soil around Arane, it is possible that the saltpeter beds, there, which are capable of supplying the whole world, are a result of the decomposition of a vast deposit of antediluvian animal remains.

Asthma.

The most popular remedies for this disorder are those used by inhalation, and experience demonstrates them the most effective. The following formula has no superior:

Grindelia	8 drachms
Jaborandi	8 "
Eucalyptus	4 "
Digitalis	4 "
Cubebs	4 "
Stramonium	16 "
Nitrate of potash	12 "
Cascarilla bark	1 "

The ingredients should be in fine powder, and thoroughly dry before mixing. The composition is used by burning from one-fourth to one-half teaspoonful, and inhaling the smoke, which is most conveniently done by using the cover of a tin box. Not only is the powder effective, but its price is reasonable, averaging about thirty-five cents per pound.

An Old Tunnel.

After years of exertion the present governor of Samos, Abyssides Pasha, has succeeded in uncovering the entrances to a tunnel of which Herodotus speaks with admiration as the work of Eupalinos and Megaira, and which, according to the same authority, was built during the tenth century B.C.

The tunnel, about five thousand feet long, was intended to secure a supply of fresh water to the old seaport town of Samos, and consists of three parts. These are: the tunnel proper, 5⅝ feet high and 6 feet wide; a canal about 5 feet deep and nearly 3 feet wide which runs in the middle or on the side of the base of the tunnel, and the aqueduct running in this canal. The aqueduct consists of earthen pipes, each 2½ feet long, 32 to 33 inches in circumference, the sides averaging about 1½ inches in thickness. Every other joint has a hole, for what purpose has not yet been fully explained. Mr. Stamatiades, a Greek archæologist, believes that they were intended to facilitate the cleaning of the pipes, and to make the flow of water easier. The canal is arched over, but twenty-eight manholes were provided to admit the workmen who were charged with cleaning and repairing the aqueduct. The tunnel is not quite straight, forming an elbow about 1,300 feet from one of the entrances. This elbow, according to Stamatiades, was caused by a mistake in the calculations of the engineers, who had none of the instruments used in tunnel building nowadays.

The tunnel starts near a small water course which may have been quite a stream in olden times, pierces the mountain Kastri, which was formerly crowned by the fort Samos, and ends a few hundred yards from the old town of Samos, about ten feet below the surface. From the mountain slope to the city this subterranean aqueduct is protected by a massive stone structure, ending within the walls of the present convent of St. John. The preservation of this work—which is truly wonderful considering the imperfect mechanical resources at the disposal of the builders—for nearly three thousand years is probably due to the care taken by Eupalinos, who in all places where the rock did not seem of sufficient firmness lined the tunnel with several layers of brick, running on the top into a peaked arch.

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COUVREUX'S EXCAVATOR WITH PIVOTING BUCKET FRAME.

Ever since the epoch at which Mr. A. Couvreux constructed his first type of excavator, which rendered so great services in excavating the Suez Canal, the use of the apparatus has been extending, and, at the present time, any work must be of small importance that does not employ it. Mr. Couvreux, who has made use of it in all his undertakings on public works, has successively introduced numerous improvements into it which we have already described.

For making large cuttings the most advantageous excavator is the one that is capable of moving over a roadway parallel with the axis thereof, and it is by means of successive diggings that the trench is enlarged to the desired dimensions. In this case the chute is on the side opposite to the chain and buckets, the car track is parallel with that of the excavator, and the loading is effected by causing all the cars to pass in succession under the spout.

This mode of operating is extremely simple, and is known to all those who have had occasion to see an excavator work. In works of less importance, such as ditching on single rail railways, a heading is made in which an advance is made right straight ahead. As the type of excavator under consideration is not adapted for working according to this method, Mr. Couvreux has studied out a new apparatus, which appears to us to be fitted to satisfy all the needs of practice.

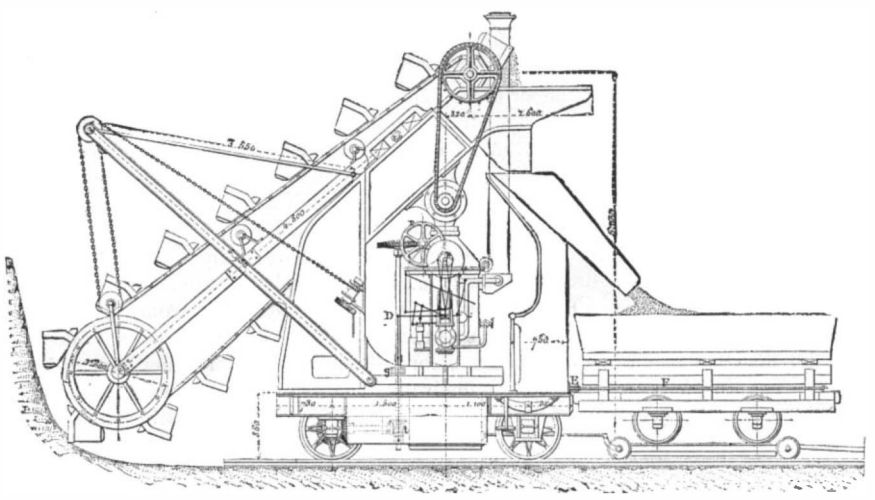

Fig. 1.—ELEVATION.—EXCAVATOR WORKING IN A TRENCH.

We must, in the first place, observe that on account of the mode of working it is more difficult to remove the excavated material where the excavator is moving forward in a trench than where it is working laterally; so it becomes necessary to study out arrangements for cheaply maneuvering the cars designed to receive the excavated material. Moreover, as this new engine was to be applicable to works of small importance, it became necessary to make it of small dimensions and of great simplicity, in order that it should be light and cheap.

In principle the bucket chain of this excavator attacks the ground, not by a forward motion of the whole, but by means of a revolution around a pivot. The forward motion occurs only at the moment when the apparatus is moved in advance over the excavated portion.

It is not without interest to remark that the similar apparatus that have already been built are got up after the type of steam cranes, where engine, boiler, and jib revolve upon a frame mounted upon rails; while the new pivoting excavator has a stationary engine and boiler that actuate a bucket chain which alone moves around a rotary axis. The excavated material falls into a chute of sufficient width to receive the earth, whatever be the angle at which the work is being done, and to carry it to the rear where the cars are to be loaded with it. Upon referring to the accompanying engravings our readers will readily understand the construction of this apparatus, the detailed study of which was made by Mr. C. Bourdon according to directions from Mr. Couvreux. As may be seen, the entire affair is fixed upon an iron frame supported by two strong axles, with the interposition of suspension springs behind only. Upon this frame there rests a large cast iron plate which receives in its center a very strong vertical boiler that serves as a frame and pivot for a great portion of the mechanism. The cylindrical shell of this generator is elevated above the smoke box, in order to receive a boiler iron disk that forms a seat for the pillow blocks of the engine and the pivot of the revolving portion.

The motor consists of two single cylinder vertical engines, fixed here and there to the boiler. They are reversible, but the eccentrics are keyed in such a way as to revolve in contrary directions. At one of the extremities of each driving shaft there is a bevel pinion that gears with a wheel which is keyed upon a vertical shaft that actuates the bucket chain.

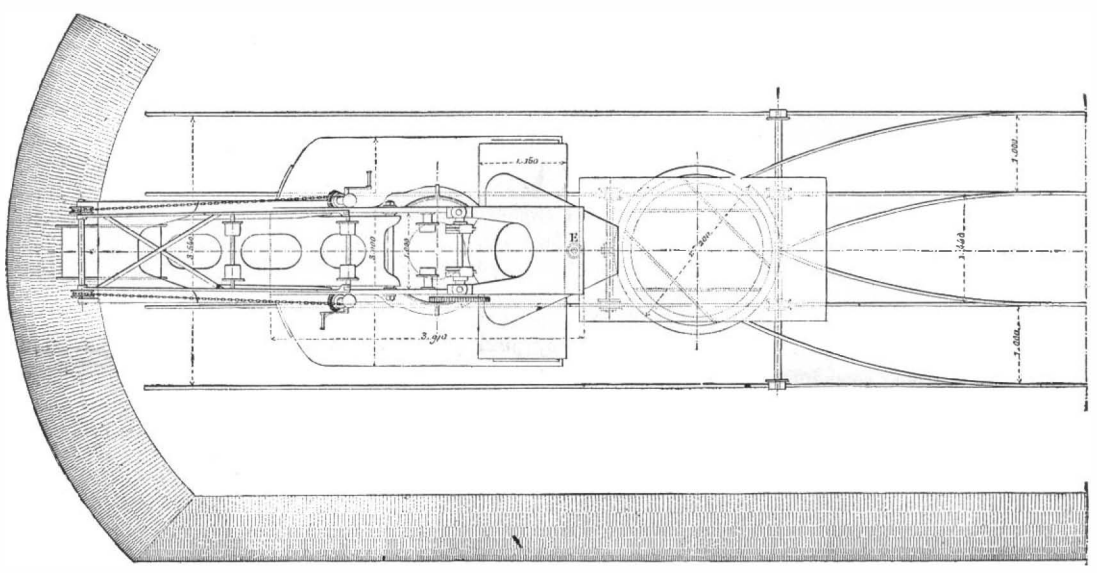

Fig. 2.—PLAN.

As a consequence of this arrangement the two engines are coupled; and, moreover, as the cranks make an angle of 90° with each other, there is no dead center.

This arrangement has been adopted with the object of simplifying the control of the various motions. As a single motor has, in fact, to actuate all the parts, it will be seen that it was necessary, during a revolution always in the same direction, to be able to turn the mechanism that actuates the upper part either to the right or left. Now as the two engines revolve in opposite directions, it is only necessary to throw the turning mechanism into gear with one or the other of the crank shafts, according to the direction in which the bucket chain is to be pivoted.

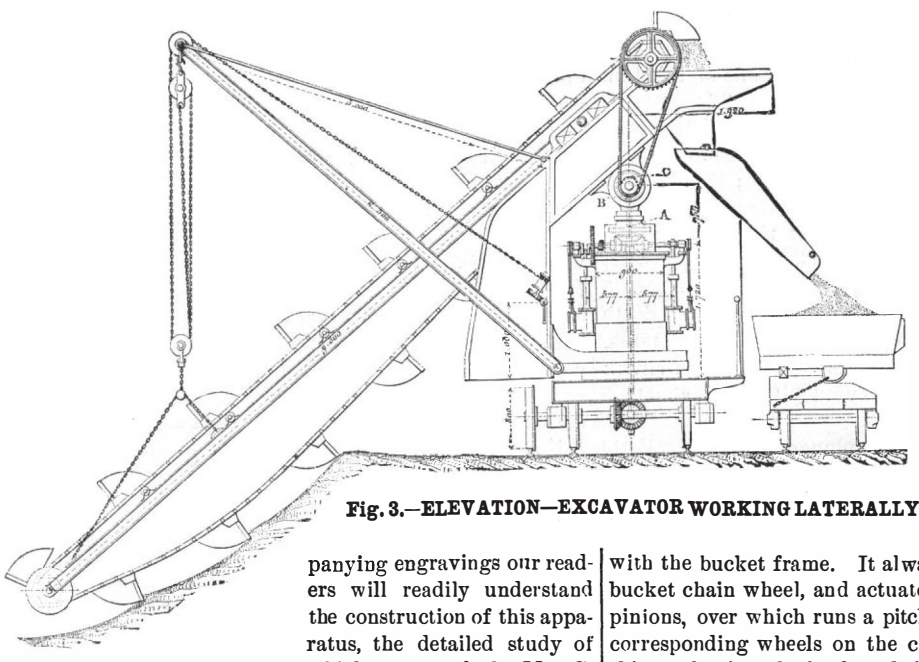

Fig. 3.—ELEVATION—EXCAVATOR WORKING LATERALLY.

The various motions are obtained by means of a very simple mechanism that presents some analogy with the system adopted for controlling radial drills. Upon an inspection of Fig. 3 it will be seen that the vertical shaft, A, rests at its lower part upon a step bearing between the two driving pinions, and that it carries at its other extremity the pinion, B, of a wheel, C, that is keyed to a horizontal shaft. This intermediate axle is supported by a cast iron piece mounted on a second step and connected with the bucket frame. It always remains parallel with the bucket chain wheel, and actuates the latter by means of two pinions, over which runs a pitch chain that passes over two corresponding wheels on the chain wheel axle. Owing to this mechanism the bucket chain, no matter what the angle be, is capable of receiving the action of the motor.

This chain is constructed in the ordinary way, and is provided with different kinds of buckets, according to the kind of work to be done. The bucket frame, which is provided with rollers and kept at the proper height by a jib and windlass, carries a chain wheel at its extremity. It passes into a boiler plate frame, which is supported above by the step bearing that we have mentioned, and below by horizontal rollers, and which rests, through the intermedium of rollers with vertical axes, against a strong circular projection cast in a piece with the bed plate.

The vertical rollers are fixed in a casting in which there is a crown wheel that serves to move the apparatus right and left. This motion comes from the engine through the intermedium of two straight pinions, *p*, which gear with the loose wheels, *r*, of an intermediate axle. These pinions and the transmitting shaft are rendered interdependent by means of coupling boxes. Consequently, this shaft revolves to the right or left, according to the pinion which actuates it. Moreover, this shaft is provided at the center with an endless screw, which, through a helicoidal wheel, revolves the vertical shaft, D. This latter carries a pinion, *g*, which drives the large crown wheel above mentioned. Finally, it is through the elongation of this axle that the mechanism, *t*, which gives the forward motion is actuated. Both the motions that we have mentioned are started or stopped by means of a lever within reach of the engineman.

At the moment of their passage over the upper tumbler the buckets empty their contents into a hopper, whence they run into a chute placed over the roof of the engineman's cab. This chute is sufficiently wide to receive the earth when the apparatus, with its hopper, is pivoting around its axis, provided, however, that the angle formed on each side of the longitudinal axis does not exceed 60°. All the excavated products are thus brought to a single point, whence they fall into the cars.

In our engravings we give two applications of this apparatus—one of them relating to trench cutting and the other to lateral excavation or widening; the cars, in the latter case, being upon a track parallel with that of the excavator. Fig. 4 shows, on a larger scale, the motion of the bucket on the upper tumbler, which actuates the endless chain through six flat surfaces, three of which are provided with teeth. The chain consists of a series of four elements each, these latter being made up of a male link which carries the bucket and three female ones. It is with the middle one of these two latter that the teeth of the tumbler engage. Finally, upon the second element of each series is fixed the movable bottom of the bucket. While the apparatus is in operation, the movable bottom remains fixed against the bucket at the points where the chain is taut, but, at the moment the bucket is passing over the surfaces of the tumbler, the two forward links of each series form an angle with each other that brings about the opening of the bucket and allows the material that it contains to drop into the hopper.

Loading the Cars.—When a pivoting excavator is employed in cases of trench cutting where the material has to be emptied to the rear, it is very difficult to dispose of the material. The majority of the methods that have been employed up to the present for substituting empty cars for full ones cause great loss of time, and necessitate long maneuvers that result from the complication of the tracks.

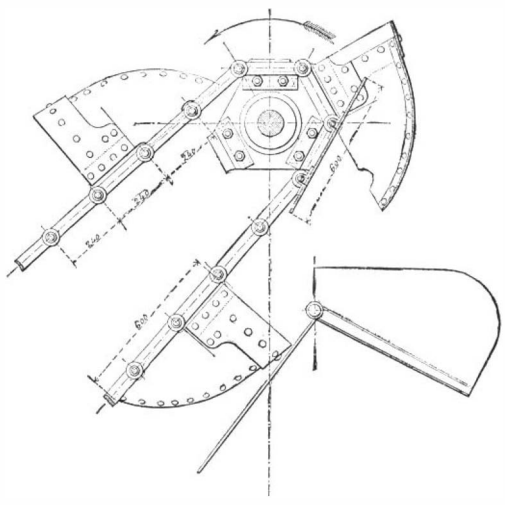

Fig. 4.—DETAILS OF UPPER TUMBLER AND BUCKET CHAIN.

In order to render his work complete, Mr. Couvreux has devised an accessory which, it seems to us, is called upon to render genuine services. In principle the carriage ought to be performed upon two parallel tracks, one of them for the empty and the other for the full cars. During the operation of loading, the engine that has hauled the empty

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train runs to a switch at a sufficient distance away to allow it to run on the other track and place itself at the head of the loaded train. As for the excavator, it must evidently advance in the axis of the trench. The width of the track upon which it runs may, at a minimum, be 1·44 m., while cars are frequently found that require a 1 meter track.

In order, then, to satisfy the two conditions of the problem without involving considerable expense in laying the tracks, the ingenious idea has struck Mr. Couvreux to utilize the center track for the excavator and to thus empty the material in the axis of the trench. It now becomes a question as to how the loaded cars shall pass. This is effected as follows: At the rear of the excavator there is a stiff bar, which is connected with a turn table carried by wheels that run on the car tracks. The top of this table is about 0·15 m. above the rails, and these two levels are connected by means of inclined planes that converge toward the center of the table. The maneuver is easily understood: An empty car is shoved up on to table, and when it is full is pushed down on to the other track, and so on, care being taken at each change of cars to close the chute so that the operation of the bucket chain need not be interrupted. It is proper to remark that in causing the car to pivot upon the table it is made to present its two extremities in succession under the spout, thus permitting of its being loaded uniformly. The stress necessary to push the empty car on to the table may be perceptibly reduced by a very simple means. To the rear of the excavator there is fixed a pulley, E (Fig. 1), over which passes a cord, F, that is attached at one of its extremities to the empty car, and at the other to the full one. Upon descending the inclined plane the full car hauls up the other, and the stress that it has to undergo moderates its speed.

In the apparatus that we have here described, the diameter of the cylinder is 0·12 m.; strokes of piston, 0·2 m.; number of revolutions, 150; register of boiler, 150 kilos.; heating surface, 7·6 square meters; capacity of water tank, 1 cubic meter; number of buckets, 15; capacity of buckets, 50 liters. —*Revue Industrielle.*

Experience with a Water Tank of Tinned Copper.

BY THEODORE DEECKE, SPECIAL PATHOLOGIST, NEW YORK STATE LUNATIC ASYLUM.

On the first of July, 1875, a water tank seventeen feet in length and eight feet in width, holding about five thousand gallons of water, was completed and taken into use in the New York State Lunatic Asylum, at Utica, N. Y. In August, the same year, its use had to be discontinued on account of leakage, and on examination it was found that at a number of places the tin lining in more or less large flakes was peeling off. The copper was not affected, and the leaks were discovered only where the plates had been soldered. Upon consultation with the writer, and from experiments made with the plates used, it was concluded that the trouble was due to a defective tinning. On direction of the Superintendent, Dr. John P. Gray, a number of samples of tinned copper were procured and subjected to suitable tests, and one selected of which a new tank was built. This stood well, and was in permanent use until May, 1884, when, in cleaning and brushing out the tank, it was found that the copper plates at the bottom were covered with small circular or oblong perforations. On closer inspection peculiar tracings in the metal were discovered in connection with these perforations, irregularly radiating in all directions from a center commonly formed by the hole. They presented an appearance as if they were excavated by a graving tool. The holes and furrows were filled out with an earthy and, when dry, quite hard material, consisting mostly of carbonate of copper. The weight of the copper was twenty ounces to the square foot; the amount of tin used could not be exactly ascertained.

The water in the tank had been in constant motion and replacement. It contained in the average, according to a number of analyses made by the writer, of inorganic salts: 16·9 grains of carbonate of lime, and 0·20 alumina, silica, etc., and 0 72 of nitrate of potassa per imperial gallon, and only traces of organic matter. Besides, rain water flowed into the tank whenever it rained.

The question arose, what produced the corrosion of the copper? Similar tanks had been in use for over twenty years without having shown evidences of similar injury.

On an inquiry by Mr. Joseph Graham, the chief engineer of the institution, at the editorial department of the SCIENTIFIC AMERICAN, accompanied by a sample of the corroded plates, the following answer was received: "Galvanic action is brought about by the influence of the water on the copper treated by the tinning process, and it would be only a question of time when the entire mass of metal would be eaten away. Munn & Co."

The writer had entertained originally the same view, yet for the following reasons regarded the explanation as unsatisfactory. First, the water constituting a slightly alkaline liquid, from the amount of carbonate of lime in it, certainly did not favor the production of galvanic action between the two metals. Secondly, the effect of the galvanic action can be but proportionate to the quantity of the metals present, and it cannot be seen why and how the comparatively small amount of tin should have led to the comparatively large consumption of copper. Besides, the corrosion of the latter is not uniformly spread over the whole surface, but confined to certain spots. Thirdly, experience had shown, for a time covering some twenty years, that the corrosion of the metal was neither of constant nor of necessary occurrence, which it would be if it was due to galvanic action.

The phenomenon, therefore invited further investigations.

Upon microscopic examination of the earthy material which filled out the furrows I found the following:

When a small piece of this substance, still moist, was placed in the center of a drop of water on a so-called life slide provided with a circular air space, and covered with a cover glass, the clear water surrounding the opaque mass was filled out in a short time with a protozoon belonging to the class of prot-amœbæ. It was not difficult to see them, in all possible shapes and sizes, creep out from the dark mass and wander slowly toward the margin of the drop bordering the air space, and the more numerous they were the more the air contained in the water was consumed.

This is a very convenient method, to which I have often resorted, of bringing micro-organisms, which live in hiding places, into view. It is air that they, like all living beings, need for their existence, and the scarcer this becomes in the isolated drop of water the more they approach from the center of the drop to its margin, which remains in contact with the air. The prot-amœbæ here observed differ from the ordinary species not so much in the peculiar shapes they assume as in the dark color of their contents, or rather in the presence of a dark, finely divided substance embedded in the otherwise transparent and colorless gelatinous little mass. By the action of diluted hydrochloric acid, under the development of a gaseous product (carbonic acid), the dark contents are dissolved into a colorless fluid, while the bodies of the prot-amœbæ mostly assume more or less spherical forms, resembling drops of oil.

Considering the great numbers in which these micro-organisms are present, their peculiar mode of life by adhering to, and of locomotion by slowly creeping over a surface, their feeding by the simple extension of their sarcode body over any material on their way, a process very likely associated with some secretory function, it seems quite probable that they exert an observable influence wherever they happen to locate. This influence is probably of a mechanical as well as of a chemical nature. When the material which fills out the furrows is removed, the perfectly pure metallic surface of the copper is brought to view, as if acted upon by the use of an acid. Thus, at first, as it seems, the copper is dissolved in minute quantities, which afterward, by the interchange of the acid with the carbonic acid of the lime salt contained in the water, form a soluble organic lime compound and carbonate of copper, the latter of which is deposited in the furrows. That a portion of this as a comparatively indifferent material is taken up by the prot-amœbæ is not surprising. They certainly do not feed on the copper. Its presence is merely accidental, and the whole phenomena, as I believe, should be looked upon from this point of view.

The species, even if brought into existence only by this peculiar combination of circumstances, may be regarded as distinct, since it has developed peculiar qualities and a mode of life of its own. The origin of the protozoon is easily explained, and must be sought in the rain water which occasionally flows into the tank, carrying down from the roof of the buildings microscopic forms of life, of which, in most places on the top of all buildings, innumerable species can be observed, and among which the prot-amœbæ are of quite common occurrence.

It is not improbable that, in perhaps many other instances, where simple experiences hitherto have been ascribed to either galvanic action or the combined and successive action of air and water, processes associated with micro-organic life are of greater importance than is known at the present time. The phenomena unquestionably invite to further researches in that direction.

Utica, June, 1884.

The Finland Polar Expedition.

M. Lemstrom has published the chief results of the Finland Polar expedition of 1883–84. The scientific observations were made at Sodankyla (latitude 67 deg. 24·6 min. north; longitude 27 deg. 17·3 min. east of Greenwich) and at Kultala (latitude 63 deg. 29 5 min. north; longitude 26 deg. 39·4 min. east). The earth currents were studied from September, 1882, to September, 1883, at the same time as the magnetic variations. Two conductors of copper wire, running from north to south and east to west for about 5 kilometers, terminated in platinum plates buried to a depth of 1·3 meters. The wires were insulated on telegraph poles, and a sensitive galvanometer was interposed in the circuit of each. Wires of iron were also used with plates about 2·5 kilometers apart.

At Kultala the earth plates were plunged in the river Fralo and its tributaries. With a Mascart electrometer giving 18 divisions for a volt, and with the galvanometer, the perturbing forces due to the polarization could be eliminated. From the fact that the variations of current in the east and west wires were very slight, M. Lemstrom is inclined to believe that there is a belt of earth currents round the pole. The magnetic variations were found to be intimately associated with those of the earth currents. The atmospheric currents were observed with the wire network, which we have already referred to in a former note. At Kultala four of these nettings of wire, with brass discharging points and zinc earth connections, were erected at different heights on a mountain side. With these it was found if two discharging nets of similar construction and at the same height were connected together through a galvanometer, no current was observed. With one net higher than the other, and both connected, a current was sent from the higher to the lower. The electromotive force of the currents observed did not rise above 0·326 volt (on March 20).

Near the surface of the earth there is a layer of air which has a much greater electric density than layers higher up. The minimum density was formed at a height of 3 to 9 meters. During the aurora the atmospheric current was always positive, that is to say, going from the atmosphere to the earth; at some other times it was negative. With regard to the artificial aurora sometimes seen crowning the discharging networks, M. Lemstrom states that they showed either diffused light or visible rays. They were observed by the naked eye and by the spectroscope, which showed the lines of the polar aurora. A Holtz machine working in connection with the wires could re-enforce the effect under favorable circumstances. If the moon was high, the phenomenon was never seen with the naked eye.

Tides and Tidal Currents.

W. O. Ayres, M.D., in the *Manufacturers' Gazette*, says: At Rio Janeiro the tide rises four feet only. On the northest side of South America, being at the narrowest part, the rise and fall are four feet or a little over. All through the Windward Islands, the Lesser Antilles, as they are marked on many maps, the range is four to five feet. Along the coast of South Carolina the rise is about 4·6 and at the Bermudas four feet; at the Delaware breakwater 4·5, and at Sandy Hook 5·6. Passing, therefore, through all the narrowing and then the subsequent widening, we have found but small change and none at latitude 40°; being at about the same width as our line of origination we have a tide equal to that of the Southern Ocean, from which it is separated by an interval of 5,000 miles.

But here, without apparently any change in the correlated surroundings, anything which can develop new vigor, a strong change commences, and presently it has become a mighty change; and it is quite apparent that this change cannot have anything to do with the shape of the land, for its potentiality is displayed on both sides of the Atlantic, the European as well as the American. We will look first to our own waters. Passing Montauk and Block Island, and striking the sandy shore of Massachusetts, we find no five foot tide, such as we had at Sandy Hook, for at Provincetown the rise is 10·8 and at Boston Light 10·9. Reaching the coast of Maine and passing on northeastward we find a tide of 20·6, and still further at St. John, N. B., of twenty-three feet. Nor is the European side to be outdone, for at Cape Finisterre, which is in the same latitude as Boston, the regular rise and fall is fifteen feet; at Brest it is nineteen, and across the chanuel at the Scilly Isles it is sixteen. On the west coast of Ireland it is fourteen; in Galway, though for local reasons, at Cape Clear it is only nine. Up the English Channel at Dover, the one side it is eighteen, while across in France, at Havre, it is twenty-two, and at St. Malo thirty-five, though this latter is somewhat influenced locally.

Now herein is much that is remarkable. We are passing further and further away from our originating impulse, and the tides, instead of losing power, are growing stronger and stronger as we get into increasing height of latitude. The fury with which their currents sweep through the contracted passages north of Scotland, separating the small islands which make the Orkney and Shetland groups, is something fearful. Even the Pentland Firth itself with all its breadth is nearly impassable except when the tide is favorable, and whoever has read Sir Walter Scott's "Pirate" needs no reminding of the dreadful rush of the current through the Roost of Sumburgh, and then over toward Norway as far up as the Arctic Circle. The world renowned Malstrom (Maelstrom we used to spell it), which is a wonderful representation of power and fury even when stripped of all its former romance of ignorance, is barely a necessary result of the dash and tear of the Lofoden tide around the south end of the little rocky island of Moskenaes between that and Mosken.

Returning now for a moment to the coast of Great Britain, we notice two mighty examples of tidal exaltation, where the great normal rise is picked up by a local configuration and made to display its points to great advantage. On the west side of the island are two funnels, so to speak, the Bristol Channel and the Firth of the Solway. The current of flood tide entering at the wide end of the funnel finds itself so restricted by the approaching sides that it has no way to expand its energy but by dashing straight forward, and away it goes, and in the head waters of each a normal daily rise and fall takes place which is immense. At Bristol it is reported at forty-four feet, and at the head of the Solway as much as fifty or more.

But in this matter of local results the whole world knows there is unbounded opportunity for "Yankee boasting," though the precise glory is rather over our line, and New Brunswick leads. The Bay of Fundy has not its equal in the world for the might of its tides. Of course they are due to the peculiar shape of the bay shores, and having greater sweep than even in the Solway they mount up most astonishingly, and while claiming only sixty feet as a common occurrence, it is asserted that when driven in by the coincidence of a favoring storm with the date of a spring tide they have been known to reach an elevation of 120 feet. This seems incredible, but I see nothing impossible in it, judging merely from the ratio of addition to a normal high tide which we often see at any of the points along our shores.

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The "Separation" Method for Sugar.

The "separation" method of sugar extraction from the beet, we are informed, has been adopted in several German factories with satisfactory results. The present method is composed of three operations: First, the preparation of the caustic lime; second, formation of the *sucrate* by precipitation; third, purification of the saccharate.

1st.—The caustic lime should be pulverized as soon as possible after leaving the lime kiln. The powdered product is thrown on a magnetized surface, where any particles of iron in the lime are separated. Every precaution is taken to prevent the absorption of moisture from the air, and for this reason the various pulverizing operations take place in hermetically sealed vessels. The thoroughly pulverized caustic lime is received in a weighing apparatus—in this latter is placed a revolving device emptying a given quantity for one operation into the saccharine solution.

2d.—The precipitation of the saccharate is effected in an apparatus called the *cooling macerator*. By suitable pipes there is circulated a cooling liquor by which the saccharine solution is kept at a very low temperature. Above the cooler is located the pulverized caustic lime measurer and two reservoirs—one for molasses to be worked, and the other for water to dilute both the molasses and the subsequent washings of the saccharate press. A certain quantity of molasses is diluted until 25 hectoliters contain 7 per cent of sugar. When the solution reaches a very low temperature in the cooling apparatus, the caustic lime is added, 5 kilos. at a time; and in about an hour nearly all the sugar is in the form of a saccharate with an excess of lime.

3d. *Purification of the Saccharate.*—The cooling apparatus is duplicate in form; one vessel being emptied by an exhaust and force pump, at a pressure of one to two atmospheres, into filter presses, the other being filled in the mean time. From the filter presses runs a liquor containing 4 to 5 per cent sugar. This is not used, however, but emptied into the waste pipe. The liquor which subsequently comes from the presses is used, as already explained, for diluting the molasses to be mixed with the caustic lime. The saccharate remaining in the filter presses is white, and of great purity.

The Method of Using the Saccharate.—The saccharate contains 100 parts of sugar to 130 of lime. If the molasses to be worked represents about 5 per cent of the weight of the beets, the saccharate obtained is mixed with the beet juice. In cases where the molasses is to be worked at once for its sugar, it is found desirable to eliminate from the saccharate the excess of lime. This is accomplished by mixing the saccharate with weak juices. The tri-basic saccharate is transformed into a calcic-mono-basic and hydrated lime, and this latter is easily separated by suitable filter presses. The liquor from the latter apparatus contains all the sugar and only 30 parts of lime to 100 of sugar. The residuum is then washed, and from it is usually obtained 4 per cent of sugar.

The Possibilities of Speed.

In a recent article on the limits of speed of ocean steamers the Boston *Herald* took the ground, substantially, that their enlargement depended upon improvements—and decided improvements—in the generation and application of power. It is not a little curious, however, that, as to at least one of the cardinal factors in locomotion, the possibilities of speed should be so much greater on water than on land, since both the average and highest speed made on the railway leave those of the ocean steamer far back in the distance. We mean what is commonly called friction.

This signifies the rubbing of the moving body upon or against the ground or water, as the case may be, when in motion. It results from the action of gravity pressing vertically down upon the body, and thus causing it to adhere to whatever it rests upon. And since gravity also enables the moving body on land to exert its own force against itself, and thus to move from place to place, it has passed into a trite saying that gravity is at once the main impediment and the indispensable auxiliary to locomotion.

Now, the degree or potency of friction depends always on the weight of the moving body; then, on land, on the manner of its adhesion to the ground and the smoothness and grade of the ground. Hence, a smooth, level, straight steel railway, and well oiled freely moving rolling gear of car, reduce friction to the minimum. On water, depth and placidity and proper shape of vessel do the same.

Now, to determine the relative potency of friction between water and land locomotion, the common incidents of canal navigation and railway freight car propulsion by horses furnish at once accurate and conclusive data.

Two horses tow all day a loaded canal boat, of a total weight of as much as 300 tons, at a speed of two miles an hour. An equal load transferred on the railway would make up a freight train of 15 loaded cars, car and load weighing ten tons each. Now, those two horses pulling on that train with the same force which they exerted in starting and towing that canal boat, so far from propelling it at the above speed of two miles an hour, would not move it at all. But load, power, and application of power being the same in both instances, the difference in the result is evidently due to the difference in the degree of potency of adhesion of the load, which is thus proved to be greater on land than on water, therefore requiring a greater force to be overcome. Now, assuming that the ratio of increase of power with increase of speed is the same on water that it is on land, since it takes so much less power at low speed to move a load on water than it does on land, always provided the application of power is the same in both cases, it follows that the increase of power demanded by the increase of speed must remain within the same original proportions, and always be much less on water than on land. And this being so, it follows that friction must also be equally less on water than on land. As to this important factor, therefore, the ocean steamer has greater possibilities of speed than the railway express.

The idea of relative friction is well taken by the *Herald* writer, but the reasoning is fallacious in the fact of drawing a deduction relative to high speeds from the comparison of the friction of a body moving in water at a low speed and the power required to overcome the static friction of a train.

These bear no relation to the relative power required to maintain a high speed of a given weight upon rail and water.

The displacement of water by a moving body is the prime factor in the advancement of marine speed, while the displacement of air and safety are the prime factors in the advancement of railway speed.

An Improved Quarantine System.

In a recent address before the representatives of the various exchanges of New Orleans, Dr. Joseph Holt, President of the Board of Health of that city, made the following suggestions:

When a vessel arrives at the mouth of the Mississippi, she is either infected or she is healthy. If we know her to be infected, she is at once removed to the supplemental or lower station, for infected vessels only, where she will be actually cleansed, actually disinfected and fumigated, her sick removed to the local hospital.

She is an exceptional case, and will be dealt with exceptionally.

She will certainly not be allowed to endanger healthy vessels by mooring in their vicinity.

If at any time she wishes to put back to sea, she is at liberty to do so; but if she desires to come to our port, she will be detained until the board can safely venture upon allowing her up.

We will understand better the particulars of treatment when we have described the course of a sailing ship through quarantine—no record of sickness on the voyage; a cargo of 30,000 bags of coffee; yellow fever epidemic in Rio, from whence she has cleared. She is brought alongside the wharf at the upper quarantine station, where she finds every arrangement for the rapid discharging and reloading of cargo. The crew with all their effects is at once taken ashore, where, in a room provided, everything they carry, apparel and baggage, is subjected to powerful disinfection. Their clothing exchanged for other clothing already treated, and this, in turn, disinfected. They are then received at a commodious boarding house, comfortably prepared for them, there to undergo the prescribed detention. If one should fall ill, he is instantly removed to the hospital as distant as can be located.

Hospital experience proves that yellow fever is conveyed through the medium, not of persons, but of things. Yellow fever has never invaded the Charity Hospital except in the regular march of an epidemic. In the mean time a full corps of acclimated stevedores are busily engaged in breaking out the cargo and transferring it to the warehouse, already built by the United States Government for that accommodation, or directly into barges, there to undergo fumigation. As soon as compactly emptied, or at least sufficiently so to permit of thorough cleansing and fumigation, the quarantine tug, a compactly built small vessel somewhat after the fashion of a fire tug for harbor protection, is run alongside the ship. A hose attached to a powerful forcing pump aboard the tug is let through the forward hatchway down into the hold.

In order to flush the bilge quickly, it might be necessary to take up the limber plank, as a better examination could be had and the real condition ascertained. But whether this is done or not, or the ship be in ballast or not, she can be speedily and thoroughly washed. The pump is started and the washing begins, while the ship's pumps are set to discharging the foul bilge water. This continues until she is washed clean, not only in the limbers and floors of the hold, but the ceiling and every available part. She is now pumped out, the hose removed, and then begins the disinfection and fumigation. Another large hose attached to a powerful exhaust fan is lowered into the same position as the first. The hatches and every other outlet are closely battened, with the exception of a small ventilating hatchway, either at the bow or stern. A quantity of sulphur is put into the furnace connected with the fan, and ignited. The exhaust fan is started, and sulphuric acid gas in immense volume and with tremendous force is driven into the limbers and air stakes, into every crevice and part of that ship until she is completely filled. We go through her with an atmosphere, as it were, of fire.

In doing this we displace the mephitic and dangerous atmosphere closed in her when she started from Rio, and which, if allowed, would have been set free at our levee—the infected atmosphere of Rio to commingle with the atmosphere of New Orleans, deadly ripe, perhaps, for its reception.

We have displaced this not only with a non-infected atmosphere, but with one intensely germicidal—one that destroys organic elements in the air or on exposed surfaces with instant greediness. As for the fumigating agent to be selected, we may use through this apparatus sulphurous acid gas, chlorine, or the nitric acid fumes produced by pouring nitric acid upon copper filings, of which Dr. Wiblin, of Southampton, says that all the goods may be safely and satisfactorily disinfected by this agent. The fumes so produced are so powerful that no animalcules can exist in them for more than two seconds, and the portholes being closed for twelve hours, the process cannot fail to be effective. For my own part, I believe that the sulphurous acid is all that we can desire.

After a few hours the hatches are removed, and pure air is driven in to facilitate clearing the ship of the fumes. She is reloaded, or her freight already sent by barge, and with her captain on board proceeds at once to the city, there to be discharged only by an acclimated gang. Her export freights must be ready. She is at once reloaded, and starts on her voyage. If the term of detention of her crew has not already expired, she touches at quarantine to take on such as have engaged to reship, and puts to sea, with no more detention than was required to cleanse her, with the utmost expedition, which alone was worth the trouble.

This method having once been enforced, we may boldly proclaim that for the first time in the history of our quarantine a ship has been actually cleansed and disinfected, purged of her suspicion.

Burning of Barns.

It is noticeable that a larger number of the burnings of barns is mentioned by the periodical press in the summer than at any other time. Some of the fires are undoubtedly caused by lightning, the moist vapor from the uncured hay making a favorable conductor for the electric fluid. But there are barn fires which cannot be attributed to lightning, to lighting of matches, to light from lanterns, nor to the invasions of careless tramps. It may be that the spontaneous combustion of hay is as possible as the spontaneous firing of cotton waste. All fibrous material, when moist, and compressed, and defended from the cooling influences of the outward air, is subjected to a heating similar to that of fermentation; and in some instances the degree of heat is sufficient to cause actual, visible combustion. In the case of recently "cured" hay this danger is as great as, in similar circumstances, other materials may be. Frequently the grass is cut in the early morning, while wet with dew; is turned twice during the day, and gathered and packed in the "mow" or the "bay" before nightfall, with perhaps a sparse sprinkling of salt. Such a compressed mass of fibrous, moist matter will heat. How far the heat will go toward generating a combustion may be inferred from a foolish trick which the writer witnessed several years ago.

A large meadow of hay had been cut, cured, and cocked, previous to removal. A shower threatening, the cocks were covered with caps of canvas and left for the night. While getting the hay in, the next day, one of the workmen dropped an unlighted match from his pocket into a cock of hay, and in a few minutes it was ablaze. It afterward was ascertained that he had spoken of the warmth of the hay as he lifted it on his fork, when a companion remarked that it might be hot enough to light a match, on which he put a match into a rick, and before they had passed on five minutes the rick was on fire.

Everybody conversant with farm life, where hay is a permanent and important crop, knows that for weeks after getting in the hay the barn is warm when the doors are opened in the morning. There is an amount of heat that is absolutely unpleasant when the thermometer outside registers 60°, but which is quite welcome with the outside temperature at 40°. This barn heat is undoubtedly from the moist hay, compacted and inclosed. The cure for the possible danger of possible spontaneous barn burning would seem to be the thorough curing—drying—of the hay before it is housed. We dry all our herbs and some of our vegetables without injuring their peculiar and individual qualities. There is no reason why hay or other fodder material stored in large masses should not be rendered equally innoxious to the influences of heat by thorough drying.

The Liquefaction of Gases.

The process of liquefying gases, such as oxygen, has been recently advanced a considerable step by the labors of M. Cailletet, who has communicated to the *Comptes Rendus* a brief preliminary account of his successful use of marsh gas for this purpose. The author recounts that, by the use of boiling ethylene, MM. Wroblewski and Olszewski have succeeded in obtaining the meniscus of liquid oxygen, which he has not himself been able to detect in any of his previous experiments. It appeared to M. Cailletet, however, that if he could find liquid bodies boiling at a temperature below that of ethylene it would thereby be possible to liquefy oxygen without being compelled to use pneumatic machines for the purpose of lowering the boiling point of the refrigerating liquid. All the necessary conditions for this purpose are fulfilled by marsh gas. In effect, this gas, slightly compressed and cooled in ethylene boiling under the ordinary atmospheric pressure, produces a colorless, exceedingly mobile liquid, which in resuming the gaseous state causes a cold sufficient for the instant liquefaction of oxygen. Under these conditions the liquefaction of oxygen becomes one of the simplest laboratory operations. M. Cailletet announces this discovery at the earliest possible moment, in order to secure priority of date; reserving the description of his methods and actual results until he has completed a course of experiments upon which he is at present engaged.

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ENGINEERING INVENTIONS.

A traction cable grip has been patented by Mr. William Martin, of San Francisco, Cal. The invention provides for a frame with grooves in which planks are fitted to slide, rollers mounted on the planks, brakes for the rollers, and means for forcing the rollers upon a cable, and the brakes upon the rollers, with various novel features, so that the running cable will be taken hold of gradually without wear thereto or shock on the car.

A balanced slide valve has been patented by Mr. Daniel A. Woodbury, of Rochester, N. Y. This invention provides for such construction as relieves the sliding faces of both the main and cut-off valves to any desired extent, a relief plate being so adjustable as to bear the entire pressure of the steam, by means under the control of the engineer, and so contrived as to accomplish the same by one movement of the adjusting device.

A car seal has been patented by Mr. Thos. P. Wentworth, of Elroy, Wis. The car having a vertical slot for receiving a seal key, a grooved block is held on the inner surface of the car and a latch held to slide in the groove, the latch adapted to engage and lock in place a seal key inserted through the slot, and having one beveled end and a head on the opposite end, making a simple and effective car door seal, the seal key having to be broken or destroyed to be removed from the outside.

MECHANICAL INVENTIONS.

A plowshare tongs has been patented by Mr. George M. Sebastian, of Arkansas City, Kansas. The tongs are composed of three members pivoted together, with a brace clamp adapted to be attached to the tongs and to the object held therein, the jaws and handles being arranged to grasp both the plowshare and the bar, holding the edges thereof to be welded together in close contact, so that a true and perfect weld may always be effected.

AGRICULTURAL INVENTIONS.

A soil pulverizer has been patented by Mr. Benjamin Deem, of Spring Hill, Kansas. In this invention the roller comprising the cylinder or drum is fitted with a core upon the axle of the carrying frame, the drum having a series of rows of slots, combined with segmental cutters, and their inner surfaces having projections or tenons fitted into sockets or mortises.

A plow has been patented by Mr. William L. Quick, of Molino, Tenn. The invention provides for such construction that plows can be readily adjusted for various kinds of plowing; a small plow can be attached to one end of the foot for cultivating close to rows of plants, and a larger plow attached to the other end for opening the furrow between the rows, etc.

A hand corn husker has been patented by Mr. Robert C. McMinn, of Golden City, Mo. The invention consists of a metal plate forked at the outer end in the form of hollow bent claws, and in means for adjusting the strap to suit different sized hands, or to pass over a mitten, so a better hold is taken on the ear of corn, and the husker is made to act more efficiently and with greater ease.

MISCELLANEOUS INVENTIONS.

A fastener for knob spindles has been patented by Mr. Le Grand Terry, of Horseheads, N. Y. This invention consists in a novel construction and arrangement of parts of knob shank, notched escutcheon, etc., making a door knob which can be locked so it cannot be turned, thus locking the door.

A neck yoke has been patented by Mr. Cyrus R. Furey, of Logansport, Ind. This invention provides a new and improved attachment for neck yokes for holding the neck yoke ring and the martingale strap, and consists in a neck yoke having a spring snap at each end.

A fireproof hanging ceiling has been patented by Mr. Louis Lafond, of New York city. This invention consists in a ceiling constructed with iron bars placed edgewise on the flanges of the iron girders, and carrying the iron hangers that support the ceiling tiles, whereby the latter will be firmly supported.

The art of treating cigars is the subject of a patent issued to Mr. James D. Culp, of San Felipe, Cal. The invention consists in applying to cigars a coat or dressing of paraffine dissolved in naphtha, to improve both their flavor and burning quality, render the wrapper more flexible and tough, and prevent drying out of the filler.

An inkstand has been patented by Mr. William O. Rastetter, of Dalton, Ohio. It is surrounded by a removable casing, on which tubes are formed, in the lower ends of which are corks or other stoppers to form feet, making a soft and yielding support for the inkstand, and preventing injury to the points of the pens passed into the tubes.

A fire escape has been patented by Mr. Eli Frazier, of North Lawrence, Kansas. This invention relates to that class of fire escapes in which an endless rope or chain is used for lowering persons, each one descending by his own weight, the friction of the rope on pulleys preventing the descent from being too rapid.

A cash carrier has been patented by Mr. George H. Spring, of Le Mars, Iowa. This invention relates to devices used in large stores for carrying the cash from the counters of the clerks to the cashier and returning the change, and involves the use of a car on a horizontal wire, being designed to simplify this system of cash carriers and expedite their action.

A cream can gauge has been patented by Mr. Charles E. De Long, of Vermillion, Dakota Ter. The can has a longitudinal slot with lateral notches at one end, and a strip creased to form pockets along the side edges, into which pockets the side edges of the slot in the can are passed, whereby the creased slip is held in the slot, a strip of glass being held in the creased strip and numerals or other characters produced thereon.

A method of hardening or improving resins of all kinds has been patented by Mr. Albert Kissel, of Frankfort-on-the-Main, Germany. This invention provides for the conversion of the acids in balsams, resins, and their compounds, by means of lime or other alkaline earths, into their respective salts, in order to harden the resins, resinous by-products, or resin preparations.

A wheel scraper has been patented by Mr. John W. Whipp, of Van Alstyne, Texas. The invention consists in a frame adapted to partly embrace the wheel and carrying longitudinal and transverse scraping wires, with means for adjusting their tension, the transverse wire having means for adjusting it vertically, and the frame being held adjustably on an arm or bar on the axle.

A door knob has been patented by Mr. Edwin A. Johnson, of Allegheny City, Pa. This invention relates to that class of knob attachments in which a serrated spindle is engaged by the edge of a key inserted through an aperture in the knob shank, and its object is to facilitate the adjustment and securing of a door knob on the knob spindle according to the thickness of the door.

An oil lamp feeder has been patented by Mr. William H. Dillon, of Glasgow, Ky. This invention consists of a special construction and combination of parts having for its object to use oil conducted like gas in pipes, to raise the lamp wick and to open the valve which admits oil thereto at the same movement; also to raise or lower the wick without operating the valve.

A bow hook for neck ties has been patented by Mr. Julius Schlesinger, of Hoboken, N. J. It is self-adjusting, formed of a piece of wire bent to form a prong, from the upper end of which two parts are inclined downward and outward on opposite sides, these parts having hooks on their free ends for receiving the shield of the bow, and the prong having a bend at its upper end.

A lock joint for fishing rods has been patented by Mr. Justice Webb, of Georgetown, Ky. With a sleeve having an annular ridge or collar and two studs is an additional sleeve fitting on the front end carrying a sliding sleeve with two L-shaped slots for receiving the stud on the other sleeve, making an improved lock joint for firmly holding together the sections of a fishing rod.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Parties having patents for sale or goods to exhibit at the Fall Exhibitions, Boston, address Chas. Babson, Jr., 24 Congress St., Boston, Mass.

Wanted.—The address of manufacturers of best Wrought Iron Pipes. E. Baumgarten, Schulenburg, Texas.

To introduce our "Patent Socket Screwdriver" we will send one to any address for 35 cents. Stamps taken. George S. Allen, Plantsville, Conn.

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The Cyclone Steam Flue Cleaner on 30 days' trial to reliable parties. Crescent Mfg. Co., Cleveland, O.

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If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent agency, 361 Broadway, New York.

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Curtis Pressure Regulator and Steam Trap. See p. 78.

Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 77.

Drop Forgings. Billings & Spencer Co., Hartford, Conn.

Brass & Copper in sheets, wire & blanks. See ad. p. 125.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 20,000 Crank Shafts and 15,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or mail, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) S. B. G. asks the rule to find the dominical letter for any year in any century. A. Rule: Divide the number of centuries and the years of the given century each by 4, and the years again by 7; multiply the remainders respectively by 2, 2, and 4; add together the three products, and increase their sum by 1; then divide the whole sum by 7, and the remainder will be the ordinal number of the dominical letter required. If 0 remain, it will be the 7th, or G. In bissextile years two dominical letters are used. Example: 1884.

$\frac{18}{4}$ = 4 and 2 rem. $2 \times 2 = 4$
$\frac{4}{4}$ = 21 and 0 rem. $0 \times 2 = 0$
$\frac{4}{7}$ = 12 and 0 rem. $0 \times 4 = 0$
4
Add 1
5

which, being less than 7, is the ordinal number for E; it being a bissextile year, F precedes E until the 1st of March, the order of the letters being reversed as applied to the succeeding years.

(2) E. H.—The disintegrating properties of steam heat at 60 pounds pressure are well known to engineers and the steam heating trade. Paper is never used except as outside covering for low pressure steam pipes, and then only as a makeshift.

(3) A. S.—You are right. Brakes should never be strongly applied to a moving train on a bridge of any size, and the best railroads prohibit such practice; when necessary to reduce speed in crossing, the brakes are applied before reaching the bridge and then released when crossing. Very likely many bridges have had their lives much shortened, and many accidents have happened, from neglect of this rule.

(4) P. B. asks how large a carbureter, or how many feet of evaporating surface, with gasoline of 87 or 88 gravity, would be required to get gas enough for eight burners of five feet an hour each. A. About 12 square feet. Less will do when the carbureter is freshly charged. 2. Suppose a ball of 25 miles in diameter could be placed 500 miles on this side of the full moon, would it not appear to be a spot on the moon to our naked eye? A. You would scarcely be able to discern a spot or shadow of a ball 25 miles diameter between the full moon and the sun at the distance named with the unaided eye. A telescope would easily show it.

(5) E. J. R. asks for a receipt of a cheap glazing for common earth ware, such as is used for common gray or brown ware. A. A brown cottage glaze consists of litharge 60 parts, flint 32 parts, brown slip 8 parts. This must be used of about the same consistency as cream color glaze, and will stand the highest temperature of heat in a common glazing oven. See also glazes for pottery, SCIENTIFIC AMERICAN SUPPLEMENT, No. 313.

(6) D. J. P. asks how the birch beer sold in saloons is made. A. A very excellent sparkling beer can be made from the sap of the birch by adding to it from 8 to 10 per cent of its weight of sugar and 0·2 to 0·3 per cent of tartaric acid. According to another authority, the best product is made by adding to 100 pounds of the sap about 6 ounces of tartaric acid and 8 to 10 (or if a stronger product is wanted 16 to 24) pounds of sugar and 3 ounces of a strong almond milk. The mixture is fermented in the usual manner, put in bottles with a little more sugar, and securely sealed. Several formulas for similar effervescing beverages are given on page 4308 of SCIENTIFIC AMERICAN SUPPLEMENT, No. 270.

(7) W. R. wishes to know what is the right temperature to raise family bread at. A. The raising of the bread should take place at a temperature of from 90° to 100° F., and the heat in the oven should be from 400° to 440° F. We suggest as interesting in this connection, Mr. George M. Whitaker's article on "Theory and Practice of Bread Making, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 170, and also Dr. Graham's paper on the Chemistry of Bread Making, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 222.

(8) L. H. F. asks: 1. What is the *modus operandi* to cook raw meats, especially corned beef, economically and with the least shrinkage, looking to its preservation? A. Each packer has his own special *modus operandi*, which is kept "strictly secret." In a general way the meat is first cooked in the ordinary way, then put into the can and sealed, boiled in this condition for some time longer, when it is removed and a vent opened in the can in order to allow all gases, etc., to escape, again hermetically sealed, boiled for a few minutes and the operation is completed. 2. Why cannot cooked corned beef and animal soups be kept from becoming rancid after being put up in air tight (so called) cans? And if deleterious gases are generated, say how caused and how prevented. A. By the foregoing process all deleterious gases are driven off, and once sealed the articles remain good for years. Deleterious gases are only induced by decomposition resulting from access to the air.

(9) F. P. H. desires to know how aluminum is taken from the ground. A. The aluminum in the ground is in the form of aluminum oxide; this is treated so as to form the double chloride of aluminum and sodium. The latter is then decomposed by heating it with metallic sodium, fluorspar or cryolite being added as a flux. SCIENTIFIC AMERICAN SUPPLEMENT, No. 50, gives in more detail the method of manufacture. Recently improved methods have been introduced, but they are essentially the same as the foregoing outline.

(10) H. M. B. asks how to make cup grease for lubricating machinery, something light colored. A. In a small boiler dissolve from 56 to 60 pounds of soda in about 3 gallons of water. In a 60 gallon boiler melt tallow, and to it add palm oil, each in quantity according to season. In summer weather, tallow, 1 cwt. 3 qrs.; palm oil, 1 cwt. 1 qr. In winter, tallow, 1 cwt. 1 qr.; palm oil 1 cwt. 3 qrs. In spring or autumn, tallow, 1 cwt. 2 qrs., palm oil, a similar quantity. As soon as the mixture boils, put out the fire and let the mixture cool down gradually, frequently stirring while cooling. When reduced to blood heat, run it off through a sieve into the solution of soda, stirring it well to insure a perfect mixture of the ingredients.

(11) S. G. writes: I keep a boarding house to make a living. For several years I have put up my own jellies and preserves, and in order to make them cheap have used apple juice to make jelly; but I find it will ferment in a few weeks' time. Can you tell me of an anti-ferment that will stop fermentation, and in what proportion is it used to a gallon of juice? A. ¼ to ½ per cent of formic acid is said to possess powerful preservative properties and to be particularly suitable for adding to fruit juices. Add it to the boiling mass. Salicylic acid is likewise used.

(12) D. D. L. desires to obtain, at a moderate cost, a compound by mixing two or more ingredients which will harden in a few minutes after being united. To answer the purpose it should become quite firm. A. If equal parts of common calcined plaster of Paris and of potassium sulphate be mixed together, they will harden in a moment with less than an equivalent weight of water; so much so indeed that the mixture cannot be poured out of the vessel. The rapidity of hardening therefore can be made to vary with the percentage of water, the mass solidifying even if 6 parts of water be used.

(13) M. B. T. writes: 1. Pure water at 60° temperature has specific gravity of 1. What is its specific gravity at 70°, 80°, and 90°? A. At 70° the specific gravity would be 0·99897, at 80° 0 99768, at 90° 0·99599. 2. Is the expansion of water regular from freezing to boiling? A. The expansion is not regular. It first contracts up to 39·2° Fah., and then expands. 3. Would sirup or honey having specific gravity of 1·4 at 60° expand the same as water with each additional 10° or 20° of heat? A. It is not likely that it would; we have no information on this subject, however. 4. What per cent of sweet has sirup that has a specific gravity of 1·4? A. About 86·5 per cent of sugar.

(14) E. J. G. asks for a recipe to prepare paper for the "blue process" of copying. A. Use two separate solutions of:

Iron and ammonium citrate	1 oz.
Water	4 oz.

and

Potassium ferricyanide	1 oz.
Water	4 oz.

For use, mix equal quantities and float paper for two minutes.

(15) J. B. H. asks the ingredients impregnating the "indelible copyable ribbon" used on type writers. A. The ink which has generally been used for the ribbons consists of:

Aniline black	½ oz.
Pure alcohol	15 "
Concentrated glycerine	15 "

Dissolve the aniline black in alcohol and add the glycerine. Recently however an ink has been prepared by using printing ink and diluting it with boiled linseed oil and adding an iron salt. We cannot vouch for the following formula, but it is similar to what is

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used: 16 parts of boiled linseed oil varnish, 6 parts of the finest lampblack, and 2 to 5 parts of iron protochloride, prepared by dissolving the iron perchloride in absolute alcohol, and adding sufficient pulverized metallic iron to reduce it to the protochloride.

(16) W. L. S.—To make very black drawings with India ink, a correspondent suggests that the pigment be cracked into small pieces and soaked in dilute ammonia water, when with an occasional shaking it will dissolve in two days; but if the ammonia is too strong, it will turn the ink brown.

(17) P. E. McD.—The limit of expansion of air has never been determined. Your other questions are too indefinite for reply here.

(18) M. J. S.—Oars are better than a screw with shaft, etc., for driving a small boat where you have only muscle power. How to build small boats of various kinds is fully described in back numbers of our SUPPLEMENT.

(19) A. H. T. & S.—Stereotypes or electrotypes which show newspaper pages, pictures, etc., in reduced or enlarged sizes are made by some of the photo-engraving processes. Such printing is also done to a considerable extent by photolithography.

(20) V. J. desires information as to how to get rid of roaches. A. Pulverized borax sprinkled around the infested places will cause them to flee.

(21) F. S. B. writes: Will you inform me what will harden tar for covering roofs. Have used resin and sulphur, but the sun makes it run. Is there anything besides asbestos that will harden it? A. You can boil the tar down as far as possible, and then cover the roof with gravel stones of a quarter to half an inch in size; or perhaps a more satisfactory method would be to mix the tar with hydraulic cement. We understand that this compound forms a very acceptable roofing material.

(22) J. L. R. asks: What chemicals will prevent the fermentation of malt soil, as it invariably, during the summer months, bursts the barrels containing it? A. Use either copperas or zinc chloride in the proportion of about one pound dissolved in one gallon of water to each barrelful.

(23) H. G. W. asks with what he can put a polish on soft gypsum. A. If it is in the rough condition, rub with finely powdered pumice stone or dried shore grass and water, then afterward with a paste formed of finely powdered and sifted slaked lime and water. The rough polish thus produced is finished by friction with finely powdered talc or French chalk until a satiny luster is produced.

(24) G. B. L. says: I have two taper wooden cones 6 inches diameter at one end, 3 inches at the other, respectively, on shafts 3 feet apart, and driven by a 1½ inch leather belt; this belt slips. What can I do to produce an even speed on the driven cone? The weight to drive can be turned by a 10 inch crank. A. Rub a little good beeswax upon the inside of the belt. If it does not drive the work at the proper tension, it is an indication that the pulleys are too small. Cone pulleys are not equal in power to straight ones with a given belt, and from their peculiar shape cannot properly carry wide belts.

(25) A. M. asks how he can get or make silver thimbles white when they are tarnished. A. Either dip them into a dilute solution of nitric acid (aqua fortis) or else silver plate them. For description of the latter process see SCIENTIFIC AMERICAN SUPPLEMENT, No. 310, under head of electrometallurgy.

(26) T. T. asks how to prepare the compound used by wood engravers to make a transfer from a print on to a type metal block. A. One ounce caustic potash to half pint alcohol should be made into a solution, with which the print is wetted for a few minutes; the type metal block is then brushed over thinly with Canada balsam, the picture put on face down, and the two run between rollers.

(27) P. S. asks: Can soluble glass (water glass) be used for inside painting? Will it mix with dry colors or mixed paints? How high a temperature will it resist or withstand? Will it be affected by dampness, or by change of temperature, etc.? A. Soluble glass can be used for inside painting. It forms the basis of the silica paints. It is quite permanent, and is not easily decomposed. It will effloresce and tend to dissolve by dampness, and is soluble in water. A good description of its properties is given on page 5061 of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 317.

(28) N. F. W. says: I have an upright tubular boiler of wrought iron 2 feet high and 1 foot diameter; the body is riveted from top to bottom with 16 rivets, I think ¼ inch rivets, the thickness of the boiler is about ⅛ inch. Should like to know about how much steam would be safe to put on it; should like to carry 80 pounds if safe. A. It would be safe at 80 pounds, if of good material and well made. We advise you to have it tested by water pressure to at least 120 pounds before using it under steam pressure.

(29) L. W. asks: Can you tell me what causes wrigglers in wells, and what will prevent or destroy them? A. These pests only occur where the well is foul; the well should be cleaned out.

(30) A. C. A. writes: 1. Could I not make my own rubber cement, with your kind assistance? It must stand hot and cold water. A. Rubber cement consists of one part raw rubber dissolved in four parts naphtha. 2. How could I vulcanize the soles of a pair of boots after being cemented on? It is necessary, for the edges will give. A. It will be impossible for you to vulcanize the soles of a pair of boots after they are cemented on. A full description of the vulcanizing process is given in back numbers of the SCIENTIFIC AMERICAN SUPPLEMENT. We do not know what you mean by rubber varnish; it is probably the same thing as the cement.

(31) J. F. N. desires to know whether hydrogen peroxide would be desirable to use in bleaching resin soap, and if not, what can be used? A. We would hardly recommend hydrogen peroxide for bleaching resin. See SUPPLEMENT, No. 319, for a description of this agent. Watt in his recent work gives the following: "When soap is made from dark colored goods, considerable improvement may be made by adding a moderate quantity of solution of chloride of soda after the first operation of saponification is complete." The best resin soap is made as far as possible from light colored resin, and is generally yellow or green. In the latter case indigo is added. We would recommend you to consult Mr. Watt's book. It is entitled The Art of Soap Making, and is worth about $2.

(32) J. G. R. asks if there is any formula for removing stains from a marble slab, caused by the acid from lemon juice. A. We should think that any stains caused by lemon juice would be easily removed by the application of cold water. The following however is strongly recommended as suitable for removing stains from marble: Take two parts common soda, one part of pumice stone, and one part of finely powdered chalk; sift it through a fine sieve, and mix it with water, then rub it well all over the marble, and the stains will be removed; then wash the marble all over with soap and water, and it will be clean as it was at first.

(33) F. K. McC. writes, asking directions how glass is stained permanently. A. Glass staining may be done at home by the following process: Spread over the glass a strong gum water, and when dry lay it over the paper on which the design is sketched, and trace with a fine hair pencil all the outlines. Dip the tube-like pencils in the colors, and let them flow out upon the glass; have a care, and not touch the pencil to the glass. The lights and shades are produced in a variety of ways; one of the easiest, and especially to beginners, is to take a goose quill cut in the shape of a pen, without the slit, and with it carefully take out the lights by lines and little dots. This part of glass staining is the most exacting and difficult, as much of the effect depends upon the shading. The glass is then ready for the kiln.

(34) A. W. M.—Full information about making lager beer, with details, and proper amounts of the ingredients to be used, will be found in SCIENTIFIC AMERICAN SUPPLEMENT, No. 217. Potatoes mix only by the ordinary means by which other plants mix; that is, by the crossing of the pistillate and stamens of the flowers. Potatoes never "mix" in the hills; new varieties are produced from the seed bulbs.

(35) P. H. L.—The pitch of a roof is measured in parts of the horizontal line from peak to eaves. In a quarter pitch, the height would be one-quarter of the width from the plumb line of the peak to the eaves. A whole pitch would be as high as wide, and equal 45°.

(36) F. W. C. C. writes: Can you inform me whether there are in the United States or Canada any institutions where the theory and practice of a mechanical engineer can be learned? If you know of any, or could put me in the way of acquiring the information, I would be much obliged to you. I am at present in the Northwest surveying, but intend returning East in the fall. Any information sent to the inclosed will find me during the summer, and will be most gratefully received. A. Write to the Stevens Institute, Hoboken, N. J., an admirable institution for your purpose.

(37) J. C. H.—To make Berlin bronze, clean the metal by first dipping for a moment in nitric acid, then rinse quickly in running water, and rub with sawdust. For the dip, to 1 gallon hot water add half a pound each of perchloride of iron and perchloride of copper. Let the articles remain in this solution no longer than for the required color, rinse well, dry, and polish with warm sawdust or a rag wheel. Copper iron by cleaning and dipping in a solution made with 3 ounces sulphate of copper, 3 ounces sulphuric acid, to one gallon water.

(38) H. T. asks: Is crude petroleum of 55° specific gravity much more dangerous to handle than the refined coal oils in general use for lighting? I do not want to use the crude article for lighting, but to run an engine—gas being too expensive at $4 per thousand cubic feet here, and the power required being mainly intermittent, and therefore steam power unavailable. A. Crude petroleum is used for generating steam, but cannot be trusted to burn with a wick. It is blown from a blow pipe with air or steam. You will find interesting articles upon petroleum as fuel in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 331 and 404.

(39) A. J. McI.—On slight exposure to the air a colorless solution of barium peroxide forms the whitish barium carbonate by taking up the carbonic acid in the air. Naturally the reaction is facilitated by the artificial introduction of carbonic acid into the surrounding atmosphere. There is also a so-called "ground glass varnish," sold by dealers in photographic supplies, which when poured on glass will rapidly dry, forming an opaque surface. Certain rare organic chemical compounds are said to possess a great sensitiveness to light, but they are not easily procurable in this country.

(40) F. L. L.—You will require for a 3 horse power boiler about 45 square feet of heating surface. The form that you have sketched we do not approve of. A bent coil around the fire chamber is better. Multiply the circumference of the pipe by its length for surface.

(41) L. B. C. asks: Will you be kind enough to tell me a cheap and harmless but efficient remedy for the falling off of the hair, and also an article to promote a healthy and abundant growth? A. The falling out of the hair may be due to many causes, and therefore no specific remedy can be recommended. Read The Hair, its Use and its Care, by Dr. J. V. Shoemaker, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 388. Morfit recommends the following. Scald black tea 2 ounces, with 1 gallon boiling water; strain, and add 3 ounces glycerine; tincture cantharides ½ ounce; and bay rum 1 quart. Mix well by shaking, and then perfume. An excess of alum in bay rum is also recommended. The growth of the hair is dependent largely upon the healthfulness of the individual, and hence no preparation can be counted as sure for this purpose, although there are many formulas such as the foregoing in existence purporting to accomplish their object.

(42) J. S. writes: Would you please let me know what the ingredients of sperm candles are, also the quantity of each ingredient? A. Melt together over a water bath 100 parts stearic acid, and 10 to 11 parts of bleached beeswax; but to insure success, the mixture must remain over the bath from 20 to 30 minutes, without being stirred or agitated. At the end of that time the fire is to be extinguished and the fluid allowed to cool until a slight pellicle is formed on the surface, when it is cast direct into the moulds, previously heated to the same temperature, with the precaution of avoiding stirring the mixture, which would cause opaqueness.

(43) H. S. asks (1) for an inexpensive means of magnetizing ordinary printing type. A. Ordinary type cannot be magnetized. 2. I want to construct a battery to experiment with. Will you direct me how to do it? A. Consult SUPPLEMENT, Nos. 157, 158, and 159, for information on batteries.

(44) D. B. asks: 1. What is the ratio of air of ordinary pressure (30 inches) to air reduced to liquid? (I do not expect more than an approximation.) A. We believe air has not yet been reduced to a liquid, although oxygen and nitrogen have. 2. What would be the rising speed of a body propelled in opposition to gravity by a constant force double that of gravity, and what the speed, raising force being four times gravity? A. The rising speed would be equal to the falling velocity caused by gravity, and 3 times that. 3 Is there any combination of lenses that would magnify 1 square cm. 625 times (25 times lineally) preserving a uniform enlargement, distinction, and proportion of different positions? A. A combination of two plano-convex lenses, as in a Ramsden eye piece, will be nearly aplanatic. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 399. 4. What is the highest practicable magnifying power for very minute objects? A. 2,000 to 3,000 diameters. 5. What is angular aperture of microscopes? A. Angular aperture is the extreme angle of the light that can be utilized for definition in a microscope objective.

(45) M. M. asks for a good and effective method of destroying the caterpillars on a grape vine, also a method of preventing them from coming on. A. There are no fewer than nineteen insect enemies of the grape, and of these, seven or eight assume the caterpillar form at some stage of their development. If the fruit has not been formed, they may as a general thing be destroyed by sprinkling the vines with a solution of Paris green or London purple with water, say a heaping tablespoonful of the former to two gallons of the latter. The vines may be dusted with a mixture of the poisons and plaster or flour, in the proportion of 1 to 100. After the fruit has formed, a kerosene soap emulsion sprinkled on the vines would be destructive to the pests without endangering human life. Take about four pounds of common yellow bar soap, one gallon of kerosene, and one gallon of water; heat the mass over the stove, stirring it till it forms a homogeneous thick yellowish liquid, then remove the mixture from the stove and continue the stirring until it becomes cool. This should be largely diluted with warm soft water, and it will be permanent. Pyrethrum powder mixed with plaster is also used to good effect, sprinkled on the vines.

(46) R. B. writes: I am manufacturing a liquid in which I use 5 per cent of acetic acid: the only difficulty I have is the smell retained by the acid. What can I use or add to overcome this? A. It is impossible to overcome the odor of acetic acid except by adding some other article of greater odoriferous power. Acetic ether or some soluble acetate, such as the sodium or the potassium salt, might be used. There are various aromatic vinegars such as the following, that may be suggestive: Take of camphor 1 ounce avoirdupois; oil of cloves, 1 drachm; oil of cedrat and lavender, of each 40 grains; oil of bergamot and thyme, of each 20 grains; oil of cinnamon, 10 grains; glacial acetic acid, half a pound; mix in a stoppered bottle and agitate until the whole of the camphor is dissolved.

(47) O. C. R. says: I have an acoustic telephone a quarter of a mile long, using No 18 iron wire with 9 inch diaphragm made of photographer's plate. It works pretty well, excepting the necessity of loud speaking; would No. 20 copper wire or a different diaphragm produce better results? A. If you will try a heavier diaphragm and use a wire cable cord, you will succeed better. You will find a thin wooden diaphragm very effective. 2. What would the materials cost for the construction of the dynamo machine described in your SUPPLEMENT, and are there no manufacturers making such small machines? A. $8 or $10. Similar machines are for sale by our leading dealers in electrical supplies.

(48) E. H. T.—Porous cups are merely unglazed earthenware. We cannot say just what the difference in force would be by using cups that were not wholly porous; but it would be in favor of the cup which is porous throughout. There are two methods of fastening electrodes to the carbons. One is to cast a lead cap directly on the carbon, the other is to make an electro deposit of copper on the end of the carbon and then solder the wires to the copper. Clamps are generally preferred, however; they are for sale by all dealers in electrical goods.

(49) O. B. S. asks for a number one recipe for cementing leather together. A. Take of common glue and American isinglass equal parts; place them in a glue pot, and add water sufficient to just cover the whole. Let it soak ten hours, then bring the whole to a boiling heat, and add pure tannin until the whole becomes ropy or appears like the white of eggs. Apply it warm. Buff the grain of the leather where it is to be cemented; rub the joint surfaces solidly together, let it dry a few hours, and it will be ready for use; and if properly put together, it will not need riveting.

(50) W. D. F. asks (1) information as to any powder or combination of powders that when mixed with hot water and spread on white paper will produce a fine gloss. A. The glazing of paper is generally effected during the process of manufacture. Coating the paper with a dilute solution of gum water might accomplish your purpose. 2. Do you know in what branches the United States Civil Service Board examine applicants, in making application for a position in the United States Treasury Department? A. *a*, Orthography, penmanship, and copying. *b*, Arithmetic, fundamental rules, fractions, and percentage. *c*, Interest, discount, and elements of bookkeeping and accounts. *d*, Elements of the English language, letter writing, and the proper construction of sentences. *e*, Elements of the geography, history, and government of the United States. 3. I saw men on the street selling a fluid in bottles, that when put on brass or copper will make it look as if it was silver plated; could you tell me what it is? A. A good silvering solution consists of a solution of 1 part potassium cyanide in 6 parts water; add to this a concentrated aqueous solution of silver nitrate (free from acid) until the precipitate is redissolved. Mix this solution with fine chalk, and apply after cleaning the objects.

(51) G. W. W.—1. Malleable castings are worth about 12 cents per pound. 2. Gasoline is a product of the distillation of petroleum, having a gravity of about 95° B. to 80° B. It is worth from 18 to 35 cents per gallon in bulk, according to its quality. 3. The iridiumpointed fountain pens seem most popular. 4. Mutilated silver coin can be sold at the United States Treasury or in quantity at the United States Assay Office, and has a value of about $1.20 per ounce.

(52) M. N. B asks what ingredients are necessary to make a hektograph. A. The composition is as follows:

Good ordinary glue	100 parts.
Glycerine	50 "
Barium sulphate (finely powdered) or the same amount of kaolin	25 "
Water	375 "

First dissolve the glue in water, heat it, add then the glycerine.

(53) A. F. O. asks how the water in bottles is frozen. A. By placing the bottles of water in the brine bath of a refrigerating machine or in a mixture of ice and salt same as used for making ice cream.

(54) H. F. says: I have a call for a machine to concave razors. Do you know if there is such a machine, and where I could get one? A. You will need only a polishing lathe with a fine emery wheel on one end of the spindle and a buff upon the other end.

(55) P. R. asks what steam pressure it would be safe to use in a boiler made of three thirty-seconds iron, 4 feet long, 15 inches diameter, with 12 1 inch flues. I want to run a cylinder 2x5 inches. Is the boiler large enough for such an engine? A. 30 pounds pressure if the seams are double riveted. Boiler is large enough for the engine.

(56) G. H. J. asks to be informed what process is used to cause the bones in canned fish to lose their bony properties so as to be easily chewed up. A. The large bones are removed; otherwise nothing is done to affect in any way the bony portion of the fish.

(57) M. & W. ask what infusorial earth is. A. Infusorial earth is diatomaceous silica or the silicious portions of the remains of microscopic life. Its chief use is for polishing purposes.

(58) W. B. E.—For steaming logs for veneering, any box that can be made so tight as not to waste steam will answer. Exhaust steam from the engine is much used for such purposes. The principal point is to get the wood thoroughly water soaked, when the heat of boiling water will make it cut freely. There is no necessity for pressure in the steam box.

(59) E. F. N.—There are a number of receipts for browning gun barrels. The following one is good for amateurs: Wet a piece of rag with chloride of antimony, dip it into olive oil, and rub the barrel over. In 48 hours it will be covered with a fine coat of rust. Then rub the barrel with a fine steel scratch brush, and wipe with a rag dipped in boiled linseed oil. Very complete directions for browning gun barrels and other useful hints may be obtained from a book, "Shooting on the Wing," by John Phin.

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AND EACH BEARING THAT DATE.

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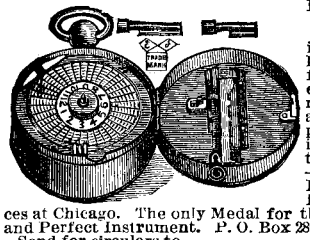

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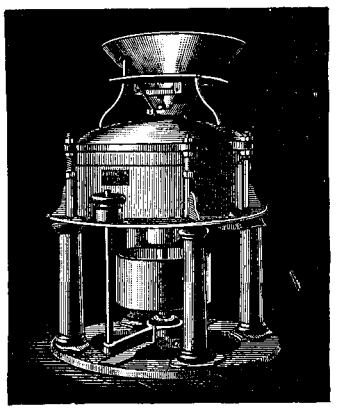

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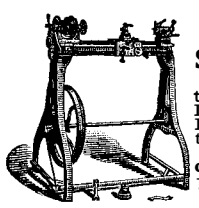

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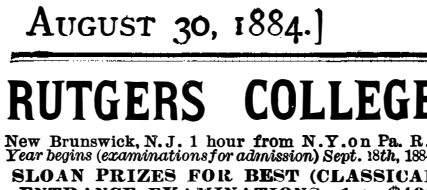

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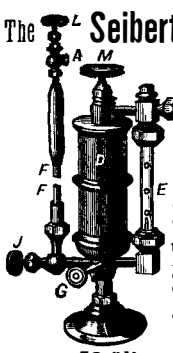

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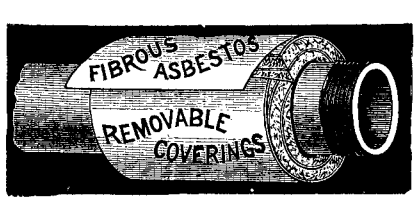

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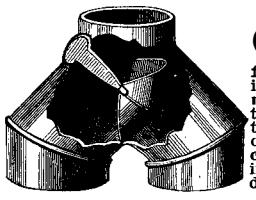

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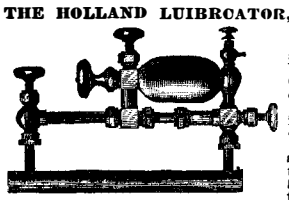

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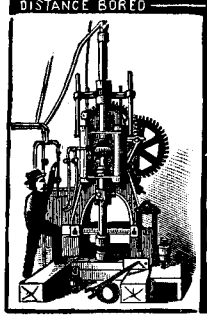

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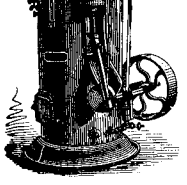

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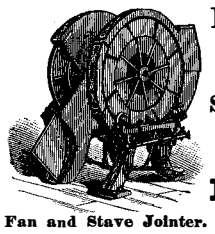

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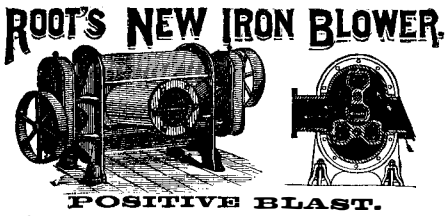

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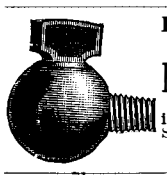

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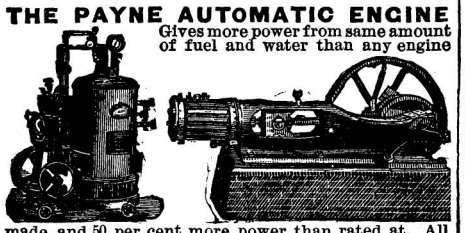

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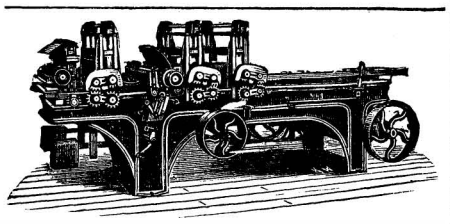

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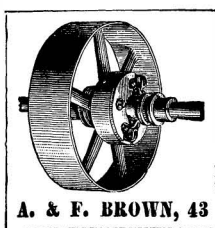

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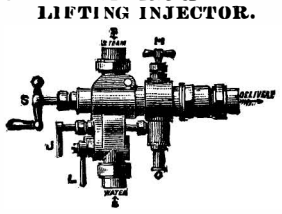

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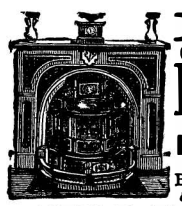

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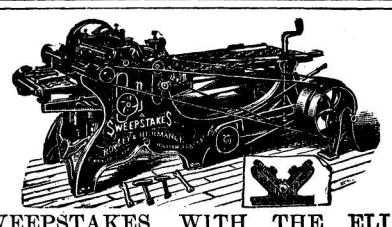

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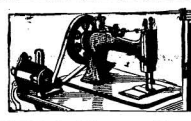

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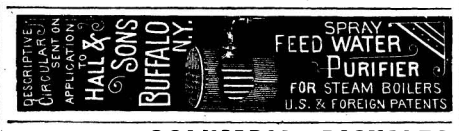

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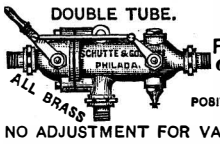

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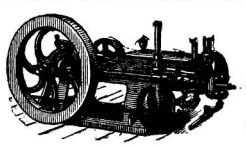

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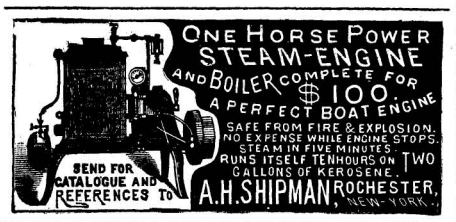
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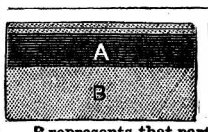

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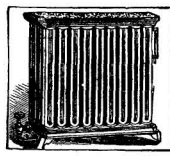

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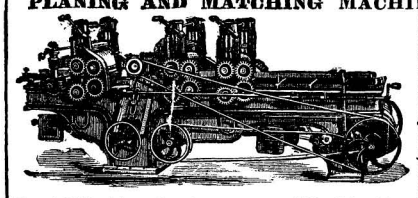

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